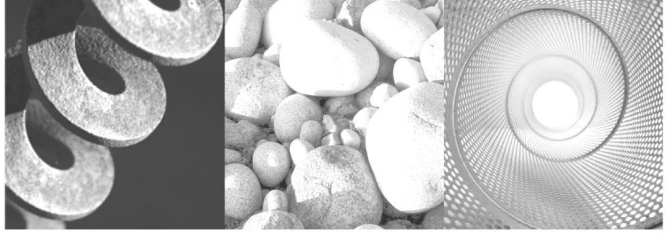

GEI Consultants

MassDEP RTN 3-23246

Release Abatement Measure Status Report No. 4

50 Tufts Street, Somerville, Massachusetts

Submitted to:
Massachusetts Department of Environmental Protection
Northeast Regional Office
150 Presidential Way
Woburn, MA 01801

Submitted by:
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May 28, 2025
Project No. 045163

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Executive Summary

GEI Consultants, Inc. prepared this Release Abatement Measure (RAM) Status Report No. 4 for Randal and Adriana Isaac (the Owners) of Somerville, Massachusetts for response actions associated with the renovation of 10 Morton Street in Somerville, Massachusetts (the Property). The Property is located within a Massachusetts Department of Environmental Protection (MassDEP) listed disposal site identified as 50 Tufts Street and assigned Release Tracking Number (RTN) 3-23246 (the Site).

The Property is a residential building within the Site boundary associated with a historic release of chlorinated Volatile Organic Compounds (VOCs) to soil and groundwater at 50 Tufts Street, located approximately 160 feet southwest of the Property across Tufts Street. From approximately 1955 to approximately 2002, 50 Tufts Street was used for storage and distribution of industrial chemicals, laundry supplies, and dry-cleaning supplies. Chemicals stored at and delivered to and from 50 Tufts Street included chlorinated solvents. These chlorinated VOCs - particularly tetrachloroethylene (PCE), trichloroethylene (TCE), and 1,1,1-trichloroethane (TCA) - have been detected in soil, soil vapor, indoor air, and groundwater at 50 Tufts Street.

In 2009, to address a potential vapor intrusion pathway, an Exposure Pathway Mitigation Measure (EPMM) was installed at the Property. In the basement, the EPMM was a new concrete floor and a vapor barrier system both beneath the floor and on the fieldstone foundation walls below the outside grade, together with a venting system beneath the vapor barrier. An Activity and Use Limitation (AUL) was placed on the Property requiring that the integrity of the EPMM be maintained.

The Property is currently undergoing renovation and remains unoccupied. As part of the renovation, the Owners lowered the basement floor by approximately one foot by demolishing the existing concrete foundation slab and sub-slab piping system and vapor barrier. Construction is being managed so as not to intercept the water table, and dewatering is not necessary. A new vapor mitigation system has been installed beneath the renovated lower floor slab.

The RAM began in June 2023 and is anticipated to be completed in the fall of 2025 when the basement foundation slab sub-slab venting, vapor barrier, and walls are reinstalled and confirmatory sub-slab soil vapor and indoor air data can be collected.

During this reporting period sub-slab soil vapor samples and indoor air samples were collected.

1. Introduction

GEI Consultants, Inc. prepared this Release Abatement Measure (RAM) Status Report No. 4 on behalf of Randal and Adriana Isaac (the Owners) for response actions associated with the renovation of 10 Morton Street in Somerville, Massachusetts (the Property; Fig. 1). The Property is located within a Massachusetts Department of Environmental Protection (MassDEP) listed disposal site identified as 50 Tufts Street and assigned Release Tracking Number (RTN) 3-23246 (the Site; Fig. 2).

1.1. Purpose

The Property is subject to an Activity and Use Limitation (AUL). The purpose of this RAM Status Report No. 4 is to comply with the requirements of the Massachusetts Contingency Plan (MCP, 310 CMR 40.0440) and the requirement of the AUL that "any proposed changes in activities and uses which may result in higher levels of exposure to oil and/or hazardous material than [existed at the time that the AUL was recorded] be evaluated by an LSP who shall render an Opinion in accordance with 310 CMR 40.1080 et seq. as to whether the proposed changes will present a significant risk of harm to health, safety, public welfare, or the environment."

This report covers work performed between October 20, 2024, and April 17, 2025.

1.2. Submittals

The MassDEP RAM Transmittal Form (BWSC106) is being submitted electronically via eDEP, and a copy is in Appendix A.

1.3. Background

The Property is in a commercial/residential zoning district, and fronts Morton Street to the northeast, and is bounded by residential property to the north, south, and west. According to the Somerville Assessor's Database, the existing residential dwelling was built in 1900. The Property is within the Site boundary associated with a historic release of chlorinated Volatile Organic Compounds (VOCs) to soil and groundwater at 50 Tufts Street, located approximately 160 feet southwest of the Property across Tufts Street. From approximately 1955 to approximately 2002, 50 Tufts Street was used for storage and distribution of industrial chemicals, laundry supplies, and dry-cleaning supplies. Chemicals stored at and delivered to and from 50 Tufts Street included chlorinated solvents. These chlorinated VOCs - particularly tetrachloroethylene (PCE), trichloroethylene (TCE), and 1,1,1-trichloroethane (TCA) - have been detected in soil, soil vapor, indoor air, and groundwater at 50 Tufts Street.

Based on the results of assessments conducted to date, the Site includes the 50 Tufts Street property, together with portions of properties in the neighborhood to the east and west. Based on multiple rounds of groundwater measurements, the general direction of groundwater flow at the Site is to the northeast across Tufts Street toward Knowlton and Franklin Streets.

1.4. Project Description

In 2009, to eliminate or mitigate a potential vapor intrusion pathway, an Exposure Pathway Mitigation Measure (EPMM) was installed at the Property. In the basement, the EPMM consisted of a new concrete floor and a vapor barrier system both beneath the floor and on the fieldstone foundation walls below the outside grade, together with a venting system beneath the vapor barrier.

Renovation of the Property includes lowering the basement floor by approximately one foot by demolishing the existing concrete foundation slab and sub-slab piping system and vapor barrier. The building remains unoccupied during renovation activities. Construction is being carried out so as not to intercept the water table, and dewatering is not necessary.

On June 21, 2023, GEI submitted a RAM Plan to address contemplated changes to activities and uses of the Property as they relate to the previously-installed EPMM. Based on historic (2007 and 2008) and recent (2023) sub-slab soil gas sampling, an updated Unit Risk Factor for PCE (2014) and the "WSC No. 16-435: Vapor Intrusion Guidance," dated October 2016 (2016 VI Guidance), GEI concluded in the RAM Plan that the EPMM was no longer required to maintain a condition of No Significant Risk (NSR) and could be demolished. However, in response to comments subsequently received from MassDEP, a RAM Plan Modification was submitted in November 2023 to provide for a sub-slab venting system and 20 mil vapor barrier to be installed during renovations and for post-installation sub-slab soil gas and indoor air testing to be conducted to evaluate whether an EPMM and an AUL are required to maintain a condition of NSR.

Excess soil generated during construction will be managed by the Owners and their contractor and is outside of the scope of this RAM. Chlorinated VOCs have not been detected above laboratory reporting limits in soil samples collected during the installation of a nearby well and a soil sample collected from beneath the slab, as described in the June 2023 RAM Plan; therefore, soil on the Property is not remediation waste associated with the Site (RTN 3-23246).

1.5. Contact Information (310 CMR 40.0444[1][a])

Responsibility for the RAM	Licensed Site Professional (LSP) for the RAM
Mr. Randal Isaac Ms. Adriana Isaac 88 Cross Street Somerville, MA 02145 781.960.7738	Ileen Gladstone, P.G., LSP, LEED AP GEI Consultants, Inc. 400 Unicorn Park Drive Woburn, MA 01801 781.424.9924 LSP License No. 9719

2. RAM Status Report No. 4

2.1. Status of Response Operations (310 CMR 40.0445[2][a])

Installation of the EPMM was completed during the previous reporting period. Renovation of the building interior is still ongoing.

2.2. New Site Information (310 CMR 40.0445[2][b])

During this reporting period two rounds of sub-slab soil vapor samples and one round of indoor air samples were collected while the sub-slab venting system was venting.

2.2.1. Sub-Slab Soil Vapor Sampling – October 2024

On October 9, 2024, GEI conducted sub-slab soil vapor sampling to evaluate the concentration of soil vapor beneath the slab post-installation of the EPMM. Samples were collected at the two sub-slab monitoring points SV5 and SV6 installed in April 2024. Installation logs for SV5 and SV6 were included in the previous RAM Status Report. The two samples were collected over a 1-hour period using stainless-steel SUMMA® canisters equipped with flow regulators. The samples were submitted to Pace Analytical Services of Mansfield, Massachusetts (Pace) for laboratory testing of chlorinated VOCs by EPA Method TO-15-SIM. The results of the soil vapor sampling are summarized in Table 1.

2.2.2. Indoor Air Sampling – March 2025

On March 18, 2025, GEI collected one indoor air sample in the basement and one indoor air sample on the first floor. The indoor air samples were collected to evaluate if there was a potential complete vapor intrusion pathway in the building. The samples were collected over a 24-hour period beginning on March 17, 2025, using stainless-steel SUMMA® canisters equipped with flow regulators. The samples were submitted to Pace for laboratory testing of chlorinated VOCs by EPA Method TO-15-SIM. The results of the indoor air sampling are summarized in Table 2. The laboratory data report is in Appendix C.

2.2.3. Sub-Slab Soil Vapor Sampling – March 2025

On March 18, 2025, following completion of the indoor air sampling, GEI collected a second round of sub-slab soil vapor samples at the two monitoring points SV5 and SV6. The two samples were collected over a 1-hour period using stainless-steel SUMMA® canisters equipped with flow regulators. The samples were submitted to Pace for laboratory testing of chlorinated VOCs by EPA Method TO-15-SIM. The results of the soil vapor sampling are summarized in Table 1. The laboratory data report is in Appendix C.

2.2.4. Soil Vapor Sampling Results

During the October 2024 soil vapor sampling, concentrations of PCE were detected above laboratory reporting limits at 12.6 µg/m^3 and 16.3 µg/m^3 in SV5 and SV6, respectively. Additionally, cis-1,2-dichloroethylene (cis-1,2-DCE; 0.153 µg/m^3), trans-1,2-dichloroethylene (trans-1,2-DCE; 336 µg/m^3), and TCE (0.228 µg/m^3) were detected in SV5, and cis-1,2-DCE (0.107 µg/m^3) and trans-1,2-DCE (291 µg/m^3) were detected in SV6. The concentrations of trans-1,2-DCE in both SV5 and SV6 are greater than the applicable residential Sub-slab Soil Gas Screening Values (SSGSV).

Results of the second round of soil vapor sampling in March 2025 were generally an order of magnitude lower than concentrations detected in October 2024. Concentrations of trans-1,2-DCE were detected above laboratory reporting limits at 12.8 µg/m^3 and 13.8 µg/m^3 in SV5 and SV6, respectively, below the residential SSGSV. Concentrations of PCE were also detected above laboratory reporting limits at 1.17 µg/m^3 and 5.78 µg/m^3 in SV5 and SV6, respectively, below the residential SSGSV. No other VOCs were detected above laboratory reporting limits during the second round of soil vapor sampling.

2.2.5. Indoor Air Sampling Results

During the March 2025 indoor air sampling, concentrations of trans-1,2-DCE were detected above laboratory reporting limits at 159 µg/m^3 and 25.3 µg/m^3 on the first floor and in the basement, respectively. Concentrations of PCE were also detected above laboratory reporting limits in the first-floor sample at 0.210 µg/m^3.

2.2.6. Discussion of Trans-1,2-Dichloroethylene

The concentrations of trans-1,2-DCE in both the first floor and basement samples are greater than the applicable residential indoor air threshold value; however, it is likely that the trans-1,2-DCE is not associated with the disposal site and is associated with the polyurethane spray foam used during home renovation based on the following lines of evidence:

- The concentrations of trans-1,2-DCE in indoor air is an order of magnitude greater on the first floor than in the basement.
- Concentrations of trans 1,2-DCE were greater in indoor air samples than in the most recent round of soil vapor sampling.
- Trans-1,2-DCE has not historically been a primary contaminant of concern in soil, groundwater, or soil gas associated with the 50 Tufts Street Site.
- Historical indoor air and sub-slab soil gas monitoring at 10 Morton Street conducted prior to building renovation never detected trans-1,2-DCE above laboratory reporting limits.
- Trans-1,2-DCE was not detected in a groundwater sample that was collected in April 2024 at monitoring well MW103, located downgradient to the east of the building in Morton Street.
- Trans-1,2-DCE has not historically been detected in groundwater at upgradient monitoring wells in the vicinity of 10 Morton Street since sampling began in 2004. Data for the October 2024 sampling event was included in the Phase V Status Report No. 27 submitted on February 11, 2025.

- According to the US Environmental Protection Agency (EPA) Risk Evaluation of trans-1,2-DCE polyurethane spray foam insulation is a common household source of trans-1,2-DCE off-gassing (Appendix D). During a site visit with the homeowner, who is also the contractor, GEI confirmed that polyurethane spray foam was used in the basement, first, and second floors during the home renovation process. The polyurethane spray foam insulation technical data sheets for 10 Morton Street are included in Appendix E.
- The spray foam insulation was first used during the basement renovation process, which coincides with higher concentrations of trans-1,2-DCE in the soil vapor initially, then decreasing during the second monitoring event. It is also consistent with higher trans-1,2-DCE concentrations detected in the first-floor indoor air than the basement.

Indoor air monitoring in the home will be suspended until the home renovation process is completed, likely in fall 2025.

2.3. Remediation Waste (310 CMR 40.0445[2][c])

No remediation waste associated with RTN 3-23246 will be managed as part of this RAM.

2.4. Other Information Required by MassDEP (310 CMR 40.0445[2][d])

No additional information has been requested by MassDEP outside of the scope of the RAM Plan and RAM Plan Modification 1.

2.5. LSP Opinion (310 CMR 40.0445[2][e])

The actions described in this status report have been performed in accordance with the RAM Plan.

3. Remediation Waste Management (310 CMR 40.0444[1][d])

No remediation waste associated with RTN 3-23246 will be managed as part of this RAM.

4. Limitations

This RAM Plan was prepared for the use of the Owners and UniFirst. The conclusions presented in this report are based solely on the information contained or referenced in this report. Additional quantitative information regarding the Site that was not available to us may result in a modification of the findings above. The report has been prepared in accordance with generally accepted geohydrological practices. No warranty, express or implied, is made.

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Tables

Table 1. Summary of Sub-Slab Soil Vapor Testing Results

Table 2. Chemical Testing Results - Indoor Air

Table 1 - Summary of Sub-Slab Soil Vapor Testing Results
10 Morton Street
Somerville, Massachusetts

			Pre-Renovation																	
		Sample Location:	10 Morton Street																	
		Sample Name:	10Mort- SG1		10MORT-SV1		10MORT-SV2		10MORT-SV3		10MORT-SV4		10MORT-SV1		10MORT-SV2		10MORT-SV3		10MORT-SV4	
		Sample Date:	5/9/2007		3/8/2023		3/8/2023		3/8/2023		3/8/2023		3/31/2023		3/31/2023		3/31/2023		3/31/2023	
		Collected by:	GEI		GEI		GEI		GEI		GEI		GEI		GEI		GEI		GEI	
		Units:	µg/m^3	ppbv	µg/m^3	ppbv	µg/m^3	ppbv	µg/m^3	ppbv	µg/m^3	ppbv	µg/m^3	ppbv	µg/m^3	ppbv	µg/m^3	ppbv	µg/m^3	ppbv
Analyte	**Method**	**Residential Sub-Slab Soil Gas Screening Values (µg/m^3)**																		
Volatile Organic Compounds (VOCs)	TO-15																			
cis-1,2-Dirchloroethylene (cis-1,2-DCE)		56	<0.79	<0.20	0.083	0.021	0.115	0.029	<0.079	<0.020	<0.079	<0.020	<0.40	<0.10	<0.40	<0.10	<0.40	<0.10	<0.40	<0.10
trans-1,2-Dirchloroethylene (trans-1,2-DCE)		56	<0.79	<0.20	<0.079	<0.020	<0.079	<0.020	<0.079	<0.020	<0.079	<0.020	<0.40	<0.10	<0.40	<0.10	<0.40	<0.10	<0.40	<0.10
Tetrachloroethylene (PCE)		98	4.0	0.59	1.06	0.156	1.32	0.194	0.183	0.027	0.292	0.043	<0.68	<0.10	<0.68	<0.10	<0.68	<0.10	<0.68	<0.10
1,1,1-Trichloroethane		210	1.2	0.22	<0.109	<0.020	<0.109	<0.020	<0.109	<0.020	<0.109	<0.020	<0.55	<0.10	<0.55	<0.10	<0.55	<0.10	<0.55	<0.10
Trichloroethylene (TCE)		28	<1.1	<0.20	<0.107	<0.020	0.258	0.048	<0.107	<0.020	<0.107	<0.020	<0.54	<0.10	<0.54	<0.10	<0.54	<0.10	<0.54	<0.10

General Notes

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m^3 = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. Concentrations in Bold exceed the Residential Sub-Slab Soil Gas Screening Values.
5. Results highlighted are the most recent samples collected.

Table 1 - Summary of Sub-Slab Soil Vapor Testing Results
10 Morton Street
Somerville, Massachusetts

			Pre-Renovation								Post-Renovation							
Sample Location:			10 Morton Street								10 Morton Street							
Sample Name:			10MORT-SV1		10MORT-SV2		10MORT-SV3		10MORT-SV4		10MORT-SV5		10MORT-SV6		10MORT-SV5		10MORT-SV6	
Sample Date:			4/24/2023		4/24/2023		4/24/2023		4/24/2023		10/9/2024		10/9/2024		3/18/2025		3/18/2025	
Collected by:			GEI		GEI		GEI		GEI		GEI		GEI		GEI		GEI	
Units:			**µg/m³**	**ppbv**	**µg/m³**	**ppbv**	**µg/m³**	**ppbv**	**µg/m³**	**ppbv**	**µg/m³**	**ppbv**	**µg/m³**	**ppbv**	**µg/m³**	**ppbv**	**µg/m³**	**ppbv**
Analyte	**Method**	**Residential Sub-Slab Soil Gas Screening Values (µg/m³)**																
Volatile Organic Compounds (VOCs)	TO-15																	
cis-1,2-Dirchloroethylene (cis-1,2-DCE)		56	<0.079	<0.020	<0.079	<0.020	<0.079	<0.020	<0.079	<0.020	0.153	0.039	0.107	0.027	<0.079	<0.020	<0.079	<0.020
trans-1,2-Dirchloroethylene (trans-1,2-DCE)		56	<0.079	<0.020	<0.079	<0.020	<0.079	<0.020	<0.079	<0.020	**336**	**84.7**	**291**	**63.0**	12.8	3.24	13.8	3.48
Tetrachloroethylene (PCE)		98	0.353	0.052	0.407	0.060	1.22	0.180	0.285	0.042	12.6	1.86	16.3	2.40	1.17	0.172	5.78	0.853
1,1,1-Trichloroethane		210	<0.109	<0.020	<0.109	<0.020	<0.109	<0.020	<0.109	<0.020	<0.201	<0.037	<0.109	<0.020	<0.109	<0.020	<0.109	<0.020
Trichloroethylene (TCE)		28	<0.107	<0.020	<0.107	<0.020	<0.107	<0.020	<0.107	<0.020	0.228	0.042	<0.107	<0.020	<0.107	<0.020	<0.107	<0.020

General Notes

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. Concentrations in Bold exceed the Residential Sub-Slab Soil Gas Screening Values.
5. Results highlighted are the most recent samples collected.

Table 2 - Chemical Testing Results - Indoor Air
10 Morton Street
Somerville, Massachusetts

			Pre-EPMM (original), Pre-Renovation											
		Sample Name:	10MORT 1		10MORT B		10MORT-1		10MORT-B		10MORT-1		10MORT-B	
		Sample Date:	8/10/07		8/10/07		11/12/07		11/12/07		2/21/08		2/21/08	
		Units:	µg/m^3	ppbv	µg/m^3	ppbv	µg/m^3	ppbv	µg/m^3	ppbv	µg/m^3	ppbv	µg/m^3	ppbv
Analyte	**Method**	**MassDEP Residential Indoor Air Threshold Values (µg/m^3)**												
Volatile Organic Compounds (VOCs)	TO-15													
Carbon tetrachloride		0.54	**0.63 J**	**0.10 J**	<1.3	<0.20	**0.69 J**	**0.11 J**	**0.62 J**	**0.099 J**	**0.63 J**	**0.10 J**	<1.3	<0.20
trans-1,2-Dichloroethene		0.8	<0.79	<0.20	<0.79	<0.20	<0.79	<0.20	<0.79	<0.20	<0.79	<0.20	<0.79	<0.20
Tetrachloroethylene (PCE)		1.4	<1.4	<0.20	**2.2**	**0.33**	<1.4	<0.20	<1.4	<0.20	**2.2**	**0.32**	**12**	**1.8**
1,1,1-Trichloroethane (TCA)		3	<1.1	<0.20	**4.3**	**0.79**	<1.1	<0.20	0.60 J	0.11 J	<1.1	<0.20	0.47 J	0.087 J
Trichloroethylene (TCE)		0.4	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m^3 = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. EPMM = Exposure Pathway Mitigation Measure.
6. The samples collected after April 2009 were collected over a 24-hour period ending on the date shown.
7. Results highlighted are the most recent samples collected.
8. Values in bold exceed the applicable MassDEP Residential Threshold Values.
9. NT = Not Tested.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Table 2 - Chemical Testing Results - Indoor Air
10 Morton Street
Somerville, Massachusetts

			Post-EPMM (original), Pre-Renovation											
		Sample Name:	10MORT-1		10MORT-B		10MORT-1		10MORT-B		10MORT-1		10MORT-B	
		Sample Date:	4/3/09		4/3/09		2/12/10		2/12/10		11/13/10		11/13/10	
		Units:	µg/m^3	ppbv	µg/m^3	ppbv	µg/m^3	ppbv	µg/m^3	ppbv	µg/m^3	ppbv	µg/m^3	ppbv
Analyte	**Method**	**MassDEP Residential Indoor Air Threshold Values (µg/m^3)**												
Volatile Organic Compounds (VOCs)	TO-15													
Carbon tetrachloride		0.54	<1.3	<0.20	<1.3	<0.20	<1.3	<0.20	<1.3	<0.20	NT	NT	NT	NT
trans-1,2-Dichloroethene		0.8	<0.79	<0.20	<0.79	<0.20	<0.79	<0.20	<0.79	<0.20	<0.79	<0.20	<0.79	<0.20
Tetrachloroethylene (PCE)		1.4	<1.4	<0.20	<1.4	<0.20	<1.4	<0.20	<1.4	<0.20	<1.4	<0.20	<1.4	<0.20
1,1,1-Trichloroethane (TCA)		3	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20
Trichloroethylene (TCE)		0.4	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20	**2.9**	**0.54**	**13**	**2.4**

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m^3 = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. EPMM = Exposure Pathway Mitigation Measure.
6. The samples collected after April 2009 were collected over a 24-hour period ending on the date shown.
7. Results highlighted are the most recent samples collected.
8. Values in bold exceed the applicable MassDEP Residential Threshold Values.
9. NT = Not Tested.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Table 2 - Chemical Testing Results - Indoor Air
10 Morton Street
Somerville, Massachusetts

			Post-EPMM (original), Pre-Renovation								Post-Renovation			
		Sample Name:	10MORT-1		10MORT-B		10MORT-1		10MORT-B		10MORT-1		10MORT-B	
		Sample Date:	12/18/10		12/18/10		3/5/11		3/5/11		3/18/25		3/18/25	
		Units:	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv
Analyte	**Method**	**MassDEP Residential Indoor Air Threshold Values (µg/m³)**												
Volatile Organic Compounds (VOCs)	TO-15													
Carbon tetrachloride		0.54	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
trans-1,2-Dichloroethene		0.8	<0.79	<0.20	<0.79	<0.20	<0.79	<0.20	<0.79	<0.20	**159**	**40.0**	**25.3**	**6.38**
Tetrachloroethylene (PCE)		1.4	<1.4	<0.20	<1.4	<0.20	<1.4	<0.20	<1.4	<0.20	0.210	0.031	<0.136	<0.020
1,1,1-Trichloroethane (TCA)		3	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20	<0.109	<0.020	<0.109	<0.020
Trichloroethylene (TCE)		0.4	<1.1	<0.20	**1.4**	**0.26**	<1.1	<0.20	**2.4**	**0.45**	<0.107	<0.020	<0.107	<0.020

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. EPMM = Exposure Pathway Mitigation Measure.
6. The samples collected after April 2009 were collected over a 24-hour period ending on the date shown.
7. Results highlighted are the most recent samples collected.
8. Values in bold exceed the applicable MassDEP Residential Threshold Values.
9. NT = Not Tested.

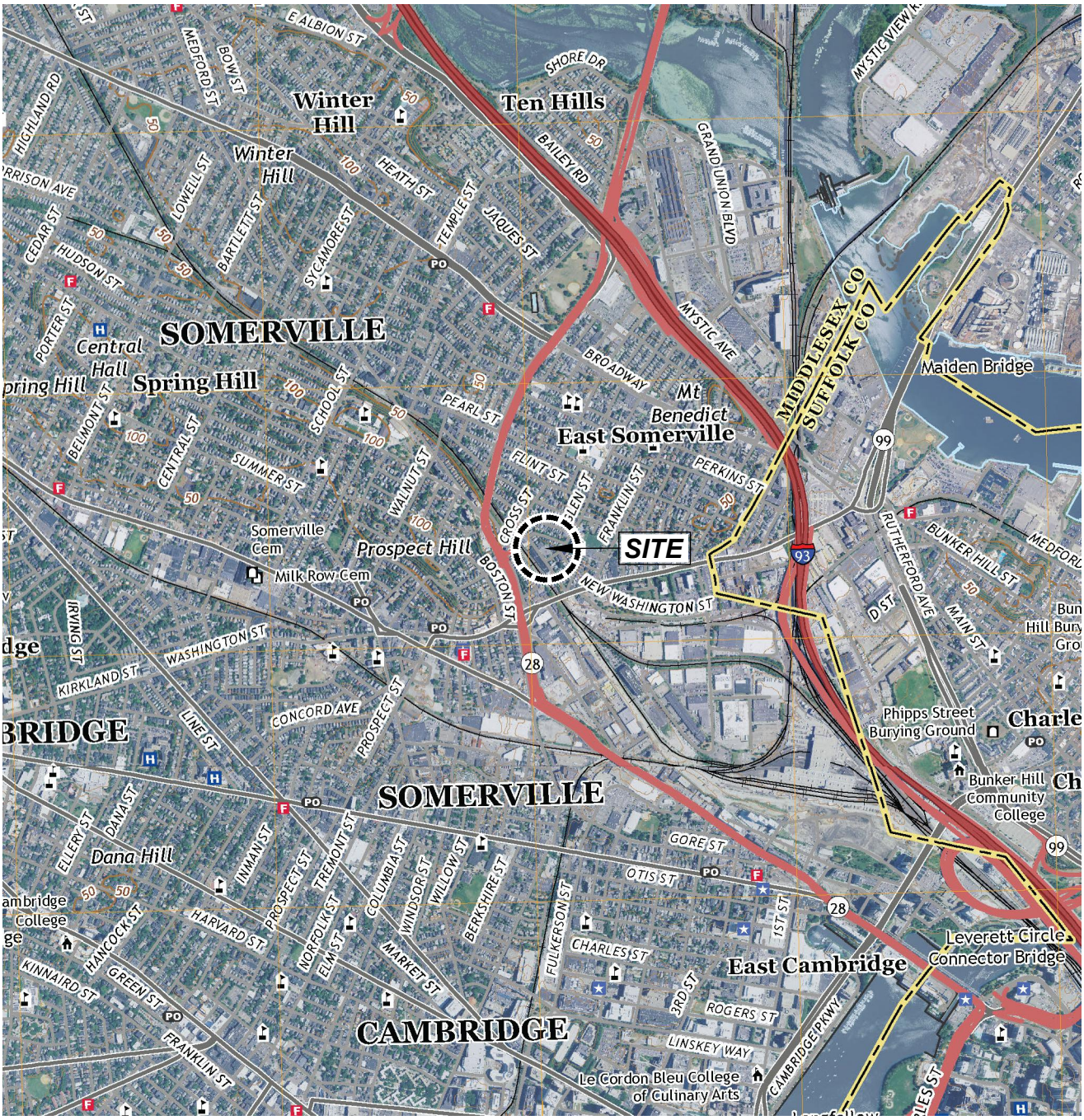
Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

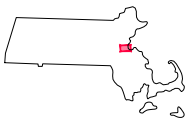
Figures

Figure 1. Site Location Map

Figure 2. Site Map



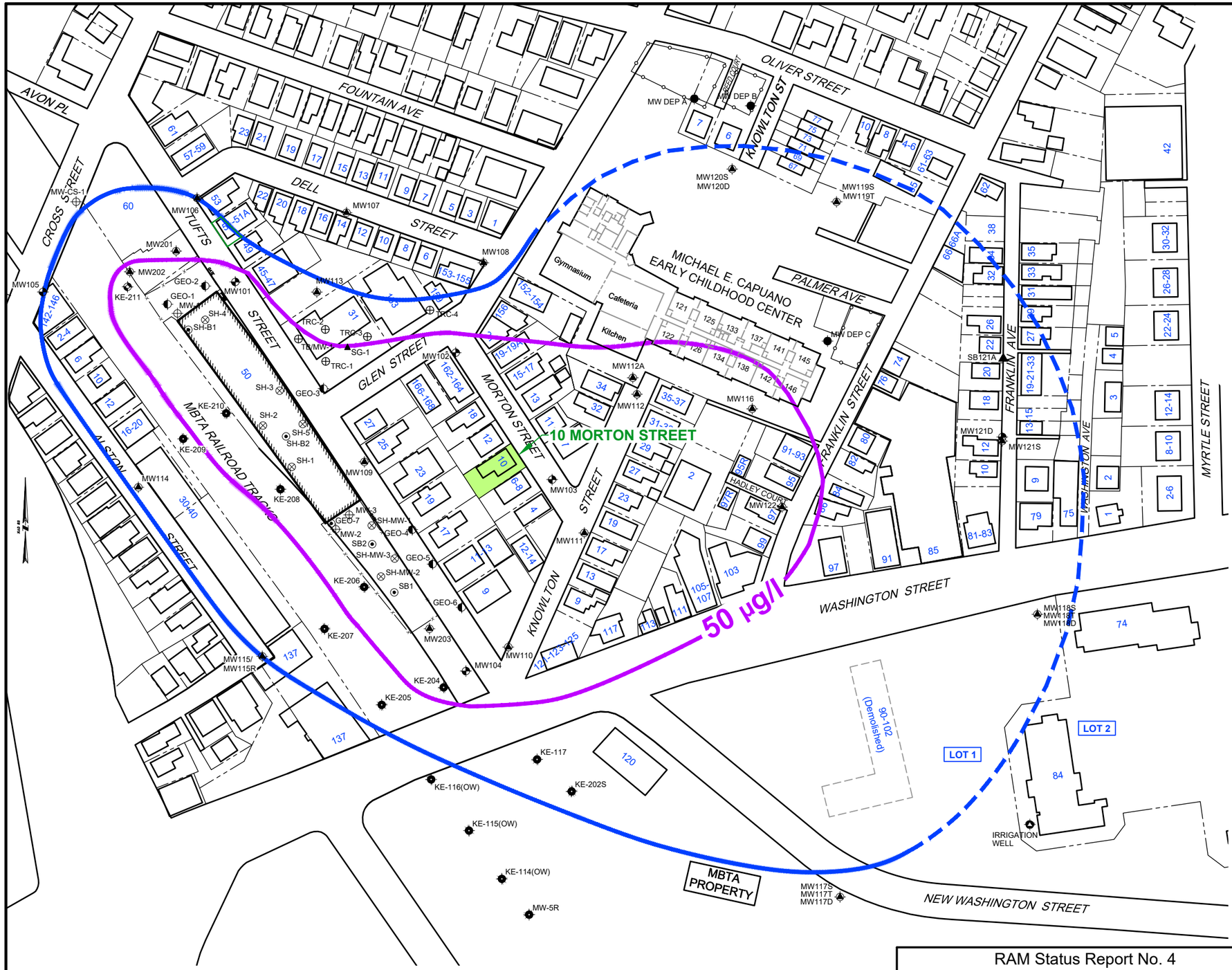
This Image is from U.S.G.S. Topographic 7.5 Minute Series
Boston North, MA Quadrangle, 2018.
Datum is North American Vertical Datum of 1988 (NAVD88).
Contour Interval is 10 Feet.



MASSACHUSETTS
QUADRANGLE LOCATION

RAM Status Report No. 4 50 Tufts Street Somerville, Massachusetts	GEI Consultants	SITE LOCATION MAP
UniFirst Corporation Wilmington, Massachusetts	Project 045163	May 2025 Fig. 1

B:\Private\04516\#Drafting\04516-3\RAM\045163 RAM slm



LEGEND:

- MONITORING WELL INSTALLED BY TRC, 2014
- SOIL GAS SAMPLING POINT BY TRC, 2014
- MONITORING WELL WITH SOIL VAPOR SAMPLE PORT INSTALLED BY GEI, JANUARY 2007 - JANUARY 2008
- MONITORING WELL BY KLEINFELDER, SEPTEMBER 2012, MARCH 2014, AND APRIL 2014
- MONITORING WELL INSTALLED BY SANBORN HEAD ASSOCIATES, 2002
- MONITORING WELL INSTALLED BY GEOINSIGHT, JUNE 2004
- SOIL BORING ADVANCED BY GEOINSIGHT, AUGUST 2004
- MONITORING WELL INSTALLED BY GEI, MAY 2006
- DRIVEN POINT MONITORING WELL INSTALLED BY MADEP, MAY 2007
- MONITORING WELL INSTALLED PREVIOUSLY, DATE UNKNOWN
- PREVIOUSLY INSTALLED IRRIGATION WELL
- 84 STREET ADDRESS
- MBTA = MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
- DISPOSAL SITE BOUNDARY (DASHED WHERE INFERRED)
- EXTENT OF PCE CONCENTRATION IN SHALLOW GROUNDWATER GREATER THAN OR EQUAL TO 50 MICROGRAMS PER LITER (µg/l)
- µg/l = MICROGRAMS PER LITER
- PORTION OF SITE SUBJECT TO THE RAM

GENERAL NOTES:

1. HORIZONTAL CONTROL FOR THIS PLAN WAS ESTABLISHED BY GPS AND IS BASED ON THE NORTH AMERICAN DATUM OF 1983.
2. STREET AND PROPERTY LINES BASED ON SOMERVILLE ASSESSORS' MAPS AND ARE BEST FIT RELATIVE TO THE LOCATION OF THE 50 TUFTS ST. BUILDING.
3. MONITORING WELL LOCATIONS WERE ESTABLISHED BASED ON THE GROUND SURVEYS BY BSC GROUP, INC.
4. GEI OBSERVED ABANDONMENT OF SH-MW1 AND SH-1 THROUGH SH-5 IN 2007.

RAM Status Report No. 4
50 Tufts Street
Somerville, Massachusetts

UniFirst Corporation
Wilmington, Massachusetts

GEI Consultants

Project 045163

10 Morton Street
Portion of Disposal Site
Subject to RAM

May 2025 Fig. 2

B:\Private\04516\#Drafting\04516-3\RAM\0451603 RAM 10 Morton St

Appendix A MassDEP Transmittal Forms

Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BWSC 106 12

Release Tracking Number
3 - 23246

RELEASE ABATEMENT MEASURE (RAM) TRANSMITTAL FORM

Pursuant to 310 CMR 40.0444 - 0446 (Subpart D)

A. SITE LOCATION:

1. Site Name/Location Aid: 50 TUFTS ST & PROP ACROSS THE ST
2. Street Address: 50 TUFTS ST
3. City/Town: SOMERVILLE 4. Zip Code: 021454129

☑ 5. Check here if the disposal site that is the source of the release is Tier Classified. Check the current Tier Classification Category.

☐ a. Tier I ☐ b. Tier ID ☑ c. Tier II

B. THIS FORM IS BEING USED TO: (check all that apply)

1. List Submittal Date of Initial RAM Plan (if previously submitted): 6/21/2023 (mm/dd/yyyy)

☐ 2. Submit an **Initial Release Abatement Measure (RAM) Plan**.

☐ a. Check here if the RAM is being conducted as part of the construction of a permanent structure. If checked, you must specify what type of permanent structure is to be erected in or in the immediate vicinity of the area where the RAM is to be conducted.

b. Specify type of permanent structure: (check all that apply) ☐ i. School ☐ ii. Residential ☐ iii. Commercial

☐ iv. Industrial ☐ v. Other Specify:

☐ 3. Submit a **Modified RAM Plan** for previously submitted RAM Plan.

☑ 4. Submit a **RAM Status Report**.

☐ 5. Submit a **Remedial Monitoring Report**. (This report can only be submitted through eDEP, concurrent with a RAM Status Report.)

a. Type of Report: (check one) ☐ i. Initial Report ☐ ii. Interim Report ☐ iii. Final Report

b. Frequency of Submittal:

☐ i. A Remedial Monitoring Report(s) submitted every six months, concurrent with a RAM Status Report.
☐ ii. A Remedial Monitoring Report(s) submitted annually, concurrent with a RAM Status Report.

c. Number of Remedial Systems and/or Monitoring Programs:

A separate BWSC106A, RAM Remedial Monitoring Report, must be filled out for each Remedial System and/or Monitoring Program addressed by this transmittal form.

☐ 6. Submit a **RAM Completion Statement**.

☐ 7. Submit a **Revised RAM Completion Statement**.

8. Provide Additional RTNs:

☐ a. Check here if this RAM Submittal covers additional Release Tracking Numbers (RTNs). RTNs that have been previously linked to a Primary Tier Classified RTN do not need to be listed here. This section is intended to allow a RAM to cover more than one unclassified RTN and not show permanent linkage to a Primary Tier Classified RTN.

b. Provide the additional Release Tracking Number(s) covered by this RAM Submittal. ☐ - ☐ ☐ - ☐

☐ 9. Include in the **RAM Plan** or **Modified RAM Plan** a **Plan for the Application of Remedial Additives** near a sensitive receptor, pursuant to 310 CMR 40.0046(3).

(All sections of this transmittal form must be filled out unless otherwise noted above)

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RELEASE ABATEMENT MEASURE (RAM) TRANSMITTAL FORM
Pursuant to 310 CMR 40.0444 - 0446 (Subpart D)

C. RELEASE OR THREAT OF RELEASE CONDITIONS THAT WARRANT RAM:

1. Media Impacted and Receptors Affected: (check all that apply)

☐ a. Paved Surface ☐ b. Basement ☐ c. School
☐ d. Public Water Supply ☐ e. Surface Water ☐ f. Zone 2 ☐ g. Private Well ☑ h. Residence ☐ i. Soil
☑ j. Ground Water ☐ k. Sediments ☐ l. Wetland ☐ m. Storm Drain ☑ n. Indoor Air ☐ o. Air
☐ p. Soil Gas ☑ q. Sub-Slab Soil Gas ☐ r. Critical Exposure Pathway ☐ s. NAPL ☐ t. Unknown
☐ u. Others Specify: _____

2. Sources of the Release or TOR: (check all that apply)

☐ a. Transformer ☐ b. Fuel Tank ☑ c. Pipe
☐ d. OHM Delivery ☐ e. AST ☑ f. Drums ☐ g. Tanker Truck ☐ h. Hose ☐ i. Line
☐ j. UST Describe: _____ ☐ k. Vehicle ☐ l. Boat/Vessel
☐ m. Unknown ☐ n. Other: _____

3. Type of Release or TOR: (check all that apply)

☐ a. Dumping ☐ b. Fire ☐ c. AST Removal ☐ d. Overfill
☐ e. Rupture ☐ f. Vehicle Accident ☐ g. Leak ☑ h. Spill ☐ i. Test Failure ☐ j. TOR Only
☐ k. UST Removal Describe: _____
☐ l. Unknown ☐ m. Other: _____

4. Identify Oils and Hazardous Materials Released: (check all that apply)

☐ a. Oils ☑ b. Chlorinated Solvents
☐ c. Heavy Metals ☐ d. Others Specify:

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D. DESCRIPTION OF RESPONSE ACTIONS: (check all that apply, for volumes list cumulative amounts)

☐ 1. Assessment and/or Monitoring Only
☐ 2. Temporary Covers or Caps
☐ 3. Deployment of Absorbent or Containment Materials
☐ 4. Temporary Water Supplies
☐ 5. Structure Venting System/HVAC Modification System
☐ 6. Temporary Evacuation or Relocation of Residents
☐ 7. Product or NAPL Recovery
☐ 8. Fencing and Sign Posting
☐ 9. Groundwater Treatment Systems
☐ 10. Soil Vapor Extraction
☐ 11. Remedial Additives
☐ 12. Air Sparging
☐ 13. Active Exposure Pathway Mitigation System
☑ 14. Passive Exposure Pathway Mitigation System
☐ 15. Monitored Natural Attenuation
☐ 16. In-Situ Chemical Oxidation

D. DESCRIPTION OF RESPONSE ACTIONS (cont.): (check all that apply, for volumes list cumulative amounts)

☐ 17. Excavation of Contaminated Soils

☐ a. Re-use, Recycling or Treatment ☐ i. On Site Estimated volume in cubic yards _____

☐ ii. Off Site Estimated volume in cubic yards _____

iia. Receiving Facility: _____ Town: _____ State: ____

iib. Receiving Facility: _____ Town: _____ State: ____

iii. Describe:

☐ b. Store ☐ i. On Site Estimated volume in cubic yards _____

☐ ii. Off Site Estimated volume in cubic yards _____

iia. Receiving Facility: _____ Town: _____ State: ____

iib. Receiving Facility: _____ Town: _____ State: ____

☐ c. Landfill ☐ i. Cover Estimated volume in cubic yards _____

Receiving Facility: _____ Town: _____ State: ____

☐ ii. Disposal Estimated volume in cubic yards _____

Receiving Facility: _____ Town: _____ State: ____

☐ 18. Removal of Drums, Tanks or Containers:

a. Describe Quantity and Amount:

b. Receiving Facility: _____ Town: _____ State: ____

c. Receiving Facility: _____ Town: _____ State: ____

☐ 19. Removal of Other Contaminated Media:

a. Specify Type and Volume:

b. Receiving Facility: _____ Town: _____ State: ____

c. Receiving Facility: _____ Town: _____ State: ____

☐ 20. Other Response Actions:

Describe:

☐ 21. Use of Innovative Technologies:

Describe:

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E. LSP SIGNATURE AND STAMP :

I attest under the pains and penalties of perjury that I have personally examined and am familiar with this transmittal form, including any and all documents accompanying this submittal. In my professional opinion and judgment based upon application of (i) the standard of care in 309 CMR 4.02(1), (ii) the applicable provisions of 309 CMR 4.02(2) and (3), and 309 CMR 4.03(2), and (iii) the provisions of 309 CMR 4.03(3), to the best of my knowledge, information and belief,

> if Section B of this form indicates that a **Release Abatement Measure Plan** is being submitted, the response action(s) that is (are) the subject of this submittal (i) has (have) been developed in accordance with the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000, (ii) is (are) appropriate and reasonable to accomplish the purposes of such response action(s) as set forth in the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000 and (iii) comply(ies) with the identified provisions of all orders, permits, and approvals identified in this submittal;

> if Section B of this form indicates that a **Release Abatement Measure Status Report** and/or **Remedial Monitoring Report** is being submitted, the response action(s) that is (are) the subject of this submittal (i) is (are) being implemented in accordance with the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000, (ii) is (are) appropriate and reasonable to accomplish the purposes of such response action(s) as set forth in the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000 and (iii) comply (ies) with the identified provisions of all orders, permits, and approvals identified in this submittal;

> if Section B of this form indicates that a **Release Abatement Measure Completion Statement** is being submitted, the response action(s) that is (are) the subject of this submittal (i) has (have) been developed and implemented in accordance with the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000, (ii) is (are) appropriate and reasonable to accomplish the purposes of such response action(s) as set forth in the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000 and (iii) comply(ies) with the identified provisions of all orders, permits, and approvals identified in this submittal:

I am aware that significant penalties may result, including, but not limited to, possible fines and imprisonment, if I submit information which I know to be false, inaccurate, or materially incomplete.

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1. LSP #: 9719
2. First Name: ILEEN S
3. Last Name: GLADSTONE
4. Telephone: 7817214012
5. Ext.:
6. Email: igladstone@geiconsultants.com
7. Signature:
8. Date: (mm/dd/yyyy)
9. LSP Stamp:

F. PERSON UNDERTAKING RAM:

1. Check all that apply: ☐ a. change in contact name ☐ b. change of address ☑ c. change in the person undertaking response actions

2. Name of Organization: RANDALL ISAAC

3. Contact First Name: RANDAL 4. Last Name: ISAAC

5. Street: 10 MORTON ST 6. Title:

7. City/Town: SOMERVILLE 8. State: MA 9. ZIP Code: 021450000

10. Telephone: 7819607738 11. Ext.: 12. Email:

G. RELATIONSHIP TO RELEASE OR THREAT OF RELEASE OF PERSON UNDERTAKING RAM:

☑ Check here to change relationship

☑ 1. RP or PRP ☐ a. Owner ☐ b. Operator ☐ c. Generator ☐ d. Transporter

☑ e. Other RP or PRP Specify: ELIGIBLE PERSON

☐ 2. Fiduciary, Secured Lender or Municipality with Exempt Status (as defined by M.G.L. c. 21E, s. 2)

☐ 3. Agency or Public Utility on a Right of Way (as defined by M.G.L. c. 21E, s. 5(j))

☐ 4. Any Other Person Undertaking RAM Specify Relationship:

H. REQUIRED ATTACHMENT AND SUBMITTALS:

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☐ 1. Check here if any Remediation Waste, generated as a result of this RAM, will be stored, treated, managed, recycled or reused at the site following submission of the RAM Completion Statement. You must submit a Phase IV Remedy Implementation Plan along with the appropriate transmittal form (BWSC 108).

☐ 2. Check here if the Response Action(s) on which this opinion is based, if any, are (were) subject to any order(s), permit(s) and/or approval(s) issued by DEP or EPA. If the box is checked, you MUST attach a statement identifying the applicable provisions thereof.

☐ 3. Check here to certify that the Chief Municipal Officer and the Local Board of Health have been notified of the implementation of a Release Abatement Measure.

☐ 4. Check here if any non-updatable information provided on this form is incorrect, e.g. Release Address/Location Aid. Send corrections to bwsc.edep@state.ma.us.

☐ 5. If a RAM Compliance Fee is required for this RAM, check here to certify that a RAM Compliance Fee was submitted to DEP, P. O. Box 4062, Boston, MA 02211.

☑ 6. Check here to certify that the LSP Opinion containing the material facts, data, and other information is attached.

RELEASE ABATEMENT MEASURE (RAM) TRANSMITTAL FORM

Pursuant to 310 CMR 40.0444 - 0446 (Subpart D)

I. CERTIFICATION OF PERSON UNDERTAKING RAM:

1. I, _____ , attest under the pains and penalties of perjury (i) that I have personally examined and am familiar with the information contained in this submittal, including any and all documents accompanying this transmittal form, (ii) that, based on my inquiry of those individuals immediately responsible for obtaining the information, the material information contained in this submittal is, to the best of my knowledge and belief, true, accurate and complete, and (iii) that I am fully authorized to make this attestation on behalf of the entity legally responsible for this submittal. I/the person or entity on whose behalf this submittal is made am/is aware that there are significant penalties, including, but not limited to, possible fines and imprisonment, for willfully submitting false, inaccurate, or incomplete information.

2. By: _____ 3. Title: _____

(Signature)

4. For: RANDALL ISAAC 5. Date: _____

(Name of person or entity recorded in Section F) (mm/dd/yyyy)

☐ 6. Check here if the address of the person providing certification is different from address recorded in Section F.

7. Street: _____

8. City/Town: _____ 9. State: _____ 10. ZIP Code: _____

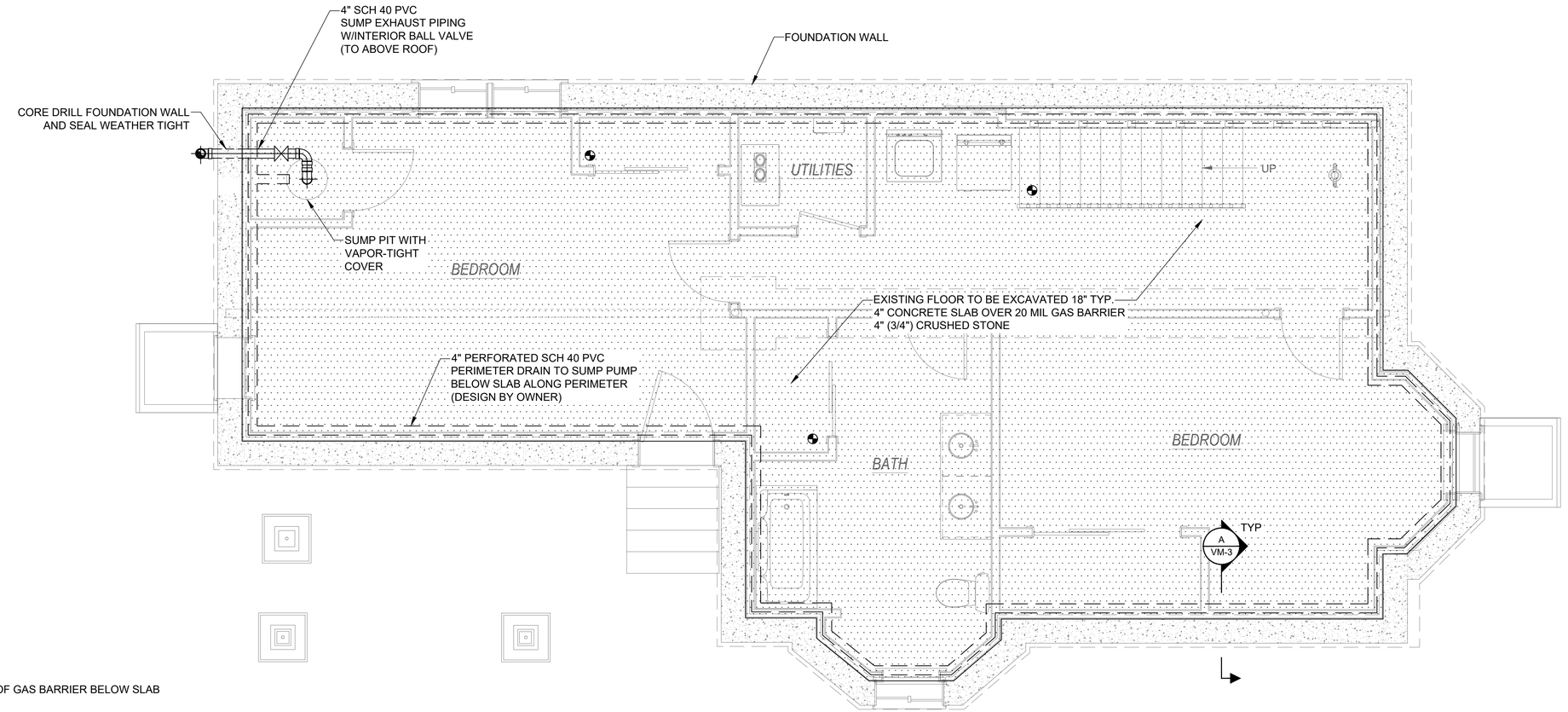
11. Telephone: _____ 12. Ext.: _____ 13. Email: _____

YOU ARE SUBJECT TO AN ANNUAL COMPLIANCE ASSURANCE FEE OF UP TO $10,000 PER BILLABLE YEAR FOR THIS DISPOSAL SITE. YOU MUST LEGIBLY COMPLETE ALL RELEVANT SECTIONS OF THIS FORM OR DEP MAY RETURN THE DOCUMENT AS INCOMPLETE. IF YOU SUBMIT AN INCOMPLETE FORM, YOU MAY BE PENALIZED FOR MISSING A REQUIRED DEADLINE

Date Stamp (DEP Use Only)

DRAFT COPY

Appendix B Sub-Slab Vapor Mitigation System Design



LEGEND

TOTAL AREA (HORIZONTAL)

876 SQ. FT.

EXTENT OF GAS BARRIER BELOW SLAB

4" PERFORATED SCH 40 PVC (SUB-SLAB BY OWNER)

VENT - 4" RISER SOLID SCH 40 PVC PIPE
(PITCH PIPE 1% TOWARD SUMP FOR CONDENSATE DRAINAGE)

SUB-SLAB MONITORING POINT LOCATION
(RESERVE LOCATIONS FOR INSTALL BY GEI)

PROPOSED BASEMENT PLAN-VAPOR MITIGATION SYSTEM

SCALE: 3/8" = 1'-0"

0 2 4
SCALE, FEET

NOTES:

1. THESE PLANS ARE INTENDED FOR THE USE OF A LICENSED CONTRACTOR. HOMEOWNER AND CONTRACTOR ARE TO VERIFY DIMENSIONS, PROPOSED LAYOUT AND BUILDING MATERIALS TO BE USED. THE CONTRACTOR IS RESPONSIBLE TO VERIFY ALL LOCAL BUILDING CODES AND INSTALL PER CODE REQUIREMENTS.
2. PLAN BASED ON "PROPOSED BASEMENT PLAN" BY CHRISTOPHER B. QUINN, 7/29/2023.
3. FOR ALL FLOOR SLAB PENETRATIONS SEE DETAIL 1/VM-3.

ISSUED FOR BID/PRICING

Attention:
0 1"
If this scale bar does not measure 1" then drawing is not original scale.

DRAFT

Designed:	L. WELCH
Drawn:	J. MORIN
Checked:	C. CONER
Approved:	I. GLADSTONE
P.E. No:	9719
GEI Project	045163

GEI Consultants
GEI CONSULTANTS, INC.
400 UNICORN PARK DRIVE
WOBURN, MA 01801
(781)721-4000

UNIFIRST CORPORATION

10 MORTON STREET
SOMMERVILLE, MASSACHUSETTS

NO	DATE	ISSUE/REVISION	APP
1	10/27/2023	ISSUED FOR BID/PRICING	LW
0	10/20/2023	INTERNAL DRAFT REVIEW	LW

SHEET NAME
PROPOSED BASEMENT PLAN VAPOR MITIGATION SYSTEM

SHEET NO.
VM-1

MORIN_JCE B:\Private\045163\12.0 Mitigation\12.2 Residences\12.2.5 Vapor Mitigation\10 Morton\00_CAD\Design\Working\045163_1103-10 Morton-Mitigation.dwg - 10/27/2023

PROPOSED REAR ELEVATION-VAPOR MITIGATION SYSTEM

SCALE: 3/8" = 1'-0"

0 2 4
SCALE, FEET

ISSUED FOR BID/PRICING

Attention:
0 1"
If this scale bar does not measure 1" then drawing is not original scale.

DRAFT

Designed:	L. WELCH
Drawn:	J. MORIN
Checked:	C. CONER
Approved:	I. GLADSTONE
P.E. No:	9719
GEI Project	045163

GEI Consultants
SELECT BLOCK AND CLICK ARROW FOR OFFICE ADDRESS!!

UNIFIRST CORPORATION

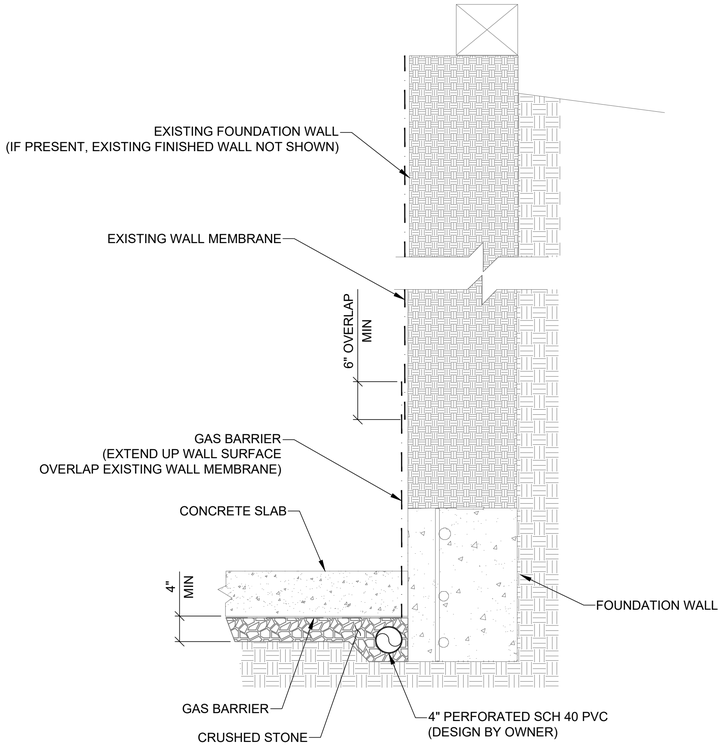
10 MORTON STREET
SOMMERVILLE, MASSACHUSETTS

NO	DATE	ISSUE/REVISION	APP
1	10/27/2023	ISSUED FOR BID/PRICING	LW
0	10/20/2023	INTERNAL DRAFT REVIEW	LW

SHEET NAME
PROPOSED REAR ELEVATION VAPOR MITIGATION SYSTEM

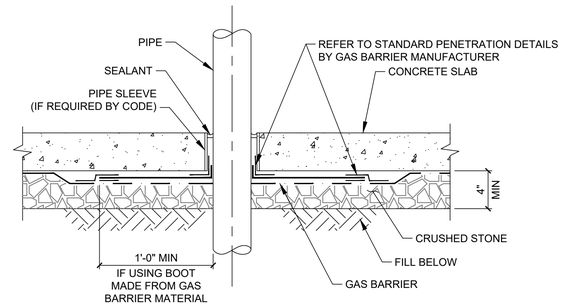
SHEET NO.
VM-2

MCRIN_JOE B:\Private\045163\12.0 Mitigation\12.2 Residences\12.2.5 Vapor Mitigation\10 Morton\00_CAD\Design\Working\045163_1103-10 Morton-Mitigation.dwg - 10/27/2023



NOTE:
WALL DRAINAGE SYSTEM NOT SHOWN FOR CLARITY
SEE STRUCTURAL DRAWINGS FOR EXISTING WALL
DRAINAGE SYSTEM.

A / VM-1 SECTION
TYPICAL GAS BARRIER INSTALLATION
SCALE: 1-1/2" = 1'-0"



1 / VM-1 DETAIL
TYPICAL GAS BARRIER AT PIPE PENETRATION
SCALE: 1-1/2" = 1'-0"

ISSUED FOR BID/PRICING

Attention:
0 1"
If this scale bar does not measure 1" then drawing is not original scale.

DRAFT

Designed:	L. WELCH
Drawn:	J. MORIN
Checked:	C. CONER
Approved:	I. GLADSTONE
P.E. No:	9719
GEI Project	045163

GEI Consultants
SELECT BLOCK AND CLICK ARROW FOR OFFICE ADDRESS!!

UNIFIRST CORPORATION

10 MORTON STREET
SOMMERVILLE, MASSACHUSETTS

NO	DATE	ISSUE/REVISION	APP
1	10/27/2023	ISSUED FOR BID/PRICING	LW
0	10/20/2023	INTERNAL DRAFT REVIEW	LW

SHEET NAME
VAPOR MITIGATION SYSTEM DETAILS

SHEET NO.
VM-3

MORIN_JOE B:\Private\045161\12.0 Mitigation\12.2 Residences\12.2.5 Vapor Mitigation\10 Morton\00_CAD\Design\Working\045163_1103-10 Morton-Mitigation.dwg - 10/27/2023

Appendix C Laboratory Data

Certification Information

The following analytes are not included in our Primary NELAP Scope of Accreditation:

Westborough Facility
EPA 624.1: m/p-xylene, o-xylene, Naphthalene
EPA 625.1: alpha-Terpineol
EPA 8260D: NPW: 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene; SCM: Iodomethane (methyl iodide), 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene.
EPA 8270E: NPW: Dimethylnaphthalene,1,4-Diphenylhydrazine, alpha-Terpineol, Azobenzene; SCM: Dimethylnaphthalene,1,4-Diphenylhydrazine.
SM4500: NPW: Amenable Cyanide; SCM: Total Phosphorus, TKN, NO2, NO3.

Mansfield Facility
SM 2540D: TSS.
EPA TO-15: Halothane, 2,4,4-Trimethyl-2-pentene, 2,4,4-Trimethyl-1-pentene, Thiophene, 2-Methylthiophene, 3-Methylthiophene, 2-Ethylthiophene, 1,2,3-Trimethylbenzene, Indan, Indene, 1,2,4,5-Tetramethylbenzene, Benzothiophene, 1-Methylnaphthalene.
Nonpotable Water: EPA RSK-175 Dissolved Gases
Biological Tissue Matrix: EPA 3050B

The following analytes are included in our Massachusetts DEP Scope of Accreditation

Westborough Facility:

Drinking Water
EPA 300.0: Chloride, Nitrate-N, Fluoride, Sulfate; **EPA 353.2**: Nitrate-N, Nitrite-N; **SM4500NO3-F**: Nitrate-N, Nitrite-N; **SM4500F-C, SM4500CN-CE, EPA 180.1, SM2130B, SM4500Cl-D, SM2320B, SM2540C, SM4500H-B, SM4500NO2-B**
EPA 524.2: THMs and VOCs; **EPA 504.1:** EDB, DBCP.
Microbiology: **SM9215B; SM9223-P/A, SM9223B-Colilert-QT,SM9222D**.

Non-Potable Water
SM4500H,B, EPA 120.1, SM2510B, SM2540C, SM2320B, SM4500CL-E, SM4500F-BC, SM4500NH3-BH: Ammonia-N and Kjeldahl-N, **EPA 350.1**: Ammonia-N, **LACHAT 10-107-06-1-B**: Ammonia-N, **EPA 351.1, SM4500NO3-F, EPA 353.2**: Nitrate-N**, SM4500P-E, SM4500P-B, E, SM4500SO4-E, SM5220D, EPA 410.4, SM5210B, SM5310C, SM4500CL-D, EPA 1664, EPA 420.1, SM4500-CN-CE, SM2540D, EPA 300: Chloride, Sulfate, Nitrate.**
EPA 624.1: Volatile Halocarbons & Aromatics,
EPA 608.3: Chlordane, Toxaphene, Aldrin, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, Dieldrin, DDD, DDE, DDT, Endosulfan I, Endosulfan II, Endosulfan sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, PCBs
EPA 625.1: SVOC (Acid/Base/Neutral Extractables).
Microbiology: **SM9223B-Colilert-QT; Enterolert-QT, EPA 1600, EPA 1603, SM9222D.**

Mansfield Facility:

Drinking Water
EPA 200.7: Al, Ba, Cd, Cr, Cu, Fe, Mn, Ni, Na, Ag, Ca, Zn. **EPA 200.8:** Al, Sb, As, Ba, Be, Cd, Cr, Cu, Pb, Mn, Ni, Se, Ag, TL, Zn. **EPA 245.1** Hg.
EPA 522, EPA 537.1.

Non-Potable Water
EPA 200.7: Al, Sb, As, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Sr, TL, Ti, V, Zn.
EPA 200.8: Al, Sb**,** As, Be, Cd, Cr, Cu, Fe, Pb, Mn, Ni, K, Se, Ag, Na, TL, Zn.
EPA 245.1 Hg.
SM2340B

For a complete listing of analytes and methods, please contact your Alpha Project Manager.

AIR ANALYSIS

PAGE 1 OF 1

CHAIN OF CUSTODY

320 Forbes Blvd, Mansfield, MA 02048
TEL: 508-822-9300 FAX: 508-822-3288

Date Rec'd in Lab: 10/11/24

ALPHA Job #: L2459340

Client Information

Client: GEI Consultants Inc.
Address: 400 Unicorn Park Dr
Woburn, 01801
Phone: 781-721-4000
Fax:
Email: labdata@geiconsultants.com

☐ These samples have been previously analyzed by Alpha

Project Information

Project Name: Tufts Street
Project Location: Somerville, MA
Project #: 045163
Project Manager: Chris Coner
ALPHA Quote #:

Turn-Around Time

☒ Standard ☐ RUSH (only confirmed if pre-approved)

Date Due: Time:

Report Information - Data Deliverables

☐ FAX
☐ ADEx
Criteria Checker:
(Default based on Regulatory Criteria Indicated)
Other Formats:
☒ EMAIL (standard pdf report)
☐ Additional Deliverables:
Report to: (if different than Project Manager)

Billing Information

☐ Same as Client info PO #:

Regulatory Requirements/Report Limits

State/Fed	Program	Res / Comm

Other Project Specific Requirements/Comments:

Project-Specific Target Compound List: ☒

All Columns Below Must Be Filled Out

ALPHA Lab ID (Lab Use Only)	Sample ID	COLLECTION End Date	Start Time	End Time	Initial Vacuum	Final Vacuum	Sample Matrix*	Sampler's Initials	Can Size	I D Can	I D - Flow Controller	ANALYSIS TO-15	TO-15 SIM	APH (Subset Non-petroleum HCs)	Fixed Gases ☐	Sulfides & Mercaptans by TO-15	Sample Comments (i.e. PID)
59340-01	045163-SV-5	10/9/24	7:59	8:59	-30.13	-9.40	SV	NMT	2.7L	2363	02335	X					see target analyte list attached
02	045163-SV-6	10/9/24	8:02	9:02	-29.97	-5.45	SV	NMT	2.7L	2009	0910	X					

*SAMPLE MATRIX CODES

AA = Ambient Air (Indoor/Outdoor)
SV = Soil Vapor/Landfill Gas/SVE
Other = Please Specify

Container Type

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Terms and Conditions. See reverse side.

Relinquished By:	Date/Time	Received By:	Date/Time:
10/11/24 1730	nicholas avoccolo 10/9/24, 12:00	GEI Fieldroom	10/9/24, 12:00
GEI Fieldroom 10.11.24	Rob Maesto 10.11.24 1235	Rob Maesto ADL 10.11.24	1130
Mark 10/11/24	10/11/24 1235	10/11/24	1235

Tufts Street IA/SV Analyte List

- Vinyl chloride
- 1,1-Dichloroethene
- trans-1,2-Dichloroethane
- 1,1-Dichloroethane
- cis-1,2-Dichloroethene
- 1,1,1-Trichloroethane
- Trichloroethene
- 1,1,2-Trichloroethane
- Tetrachloroethene
- 1,1,2,2-Tetrachloroethane

Serial_No:10172416:56

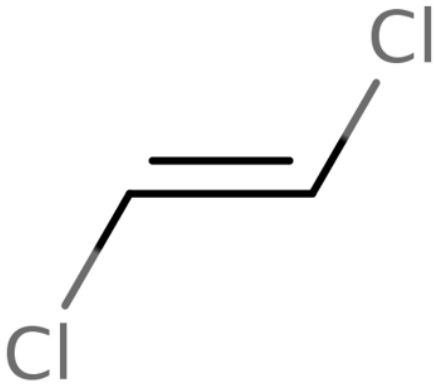
Appendix D Final Scope of the Risk Evaluation for trans-1,2-Dichloroethylene

EPA Document# EPA-740-R-20-007
August 2020
Office of Chemical Safety and
Pollution Prevention

United States
Environmental Protection Agency

Final Scope of the Risk Evaluation for *trans*-1,2-Dichloroethylene

CASRN 156-60-5



August 2020

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ACKNOWLEDGEMENTS

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Acknowledgements

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Docket

Supporting information can be found in public docket: EPA-HQ-OPPT-2018-0465.

Disclaimer

Reference herein to any specific commercial products, process or service by trade name, trademark, manufacturer or otherwise does not constitute or imply its endorsement, recommendation or favoring by the United States Government.

ABBREVIATIONS AND ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
ACS	American Chemical Society
ADME	Absorption, Distribution, Metabolism, and Excretion
AIA	Aerospace Industries Association
ATSDR	Agency for Toxic Substances and Disease Registry
AWQC	Ambient Water Quality Criteria
BAF	Bioaccumulation Factor
BCF	Bioconcentration Factor
BMF	Biomagnification factor
BOD	Biochemical Oxygen Demand
BP	Boiling Point
$BW^{3/4}$	Body Weight ¾ Extrapolation
CAA	Clean Air Act
CalEPA	California Environmental Protection Agency
CASRN	Chemical Abstracts Service Registry Number
CBI	Confidential Business Information
CDC	Centers for Diseases Control and Prevention
CDR	Chemical Data Reporting
CEHD	Chemical Exposure Health Data
CEM	Consumer Exposure Model
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFC-113	1,1,2-Trichloro-1,2,2-trifluoroethane
CFCs	Chlorofluorocarbons
CFR	Code of Federal Regulations
ChemSTEER	Chemical Screening Tool for Occupational Exposures and Releases
CHRIP	Chemical Risk Information Platform
COC	Concentration of Concern
CPCat	Chemical and Product Categories
CPDat	Consumer Product Database
CRC	Coordinating Research Council
CSCL	Chemical Substances Control Law
CWA	Clean Water Act
DCE	1,2-Dichloroethylene
DMR	Discharge Monitoring Report
EC	Engineering Control(s)
ECHA	European Chemicals Agency
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
EPI	Estimation Programs Interface
ERG	Eastern Research Group
ESD	Emission Scenario Document
EU	European Union
FR	Federal Register
FYI	For your information
GDIT	General Dynamics Information Technology
GESTIS	Substance Database contains information for the safe handling of hazardous substances and other chemical substances at work

GS	Generic Scenario
HCFCs	Hydrochlorofluorocarbons
HERO	Health and Environmental Research Online
HFO	Hydrofluoroolefins
HHE	Health Hazard Evaluation
HMTA	Federal Hazardous Materials Transportation Act
HSDB	Hazardous Substances Data Bank
IBCs	Intermediate Bulk Containers
ICF	ICF is a global consulting services company
ICH	International Council for Harmonisation
IMAP	Inventory Multi-Tiered Assessment and Prioritisation (Australia)
IRIS	Integrated Risk Information System
ISHA	Industrial Safety and Health Act
IUPAC	International Union of Pure and Applied Chemistry
K_{OC}	Organic Carbon: Water Partition Coefficient
K_{OW}	Octanol: Water Partition Coefficient
KOECT	Kirk-Othmer Encyclopedia of Chemical Technology
LC_{50}	50% Lethal Concentration
LC_x	Lethal Concentration
LOAELs	Lowest Observed Adverse Effect Level
LOEC	Lowest Observed Effect Concentration
MACT	Maximum Achievable Control Technology
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MITI	Ministry of International Trade and Industry
MOA	Mode of Action
MP	Melting Point
MSW	Municipal Solid Waste
NEI	National Emissions Inventory
NEWMOA	Northeast Waste Management Officials' Association
NHANES	National Health and Nutrition Examination Survey
NICNAS	National Industrial Chemicals Notification and Assessment Scheme (Australia)
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
NITE	National Institute of Technology and Evaluation
NLM	National Library of Medicine
NOAELs	No Observed Adverse Effect Level
NOEC	No Observed Effect Concentration
NPDES	National Pollutant Discharge Elimination System
NPDWR	National Primary Drinking Water Regulation
NPL	National Priorities List
NTP	National Toxicology Program
OCSPP	Office of Chemical Safety and Pollution Prevention
OECD	Organisation for Economic Co-operation and Development
OEHHA	Office of Environmental Health Hazard Assessment (California)
OELs	Occupational Exposure Limits
ONU	Occupational Non-User
OPPT	Office of Pollution Prevention and Toxics

OSHA	Occupational Safety and Health Administration
OTVDs	Open Top Vapor Degreasers
OW	EPA's Office of Water
PBPK	Physiologically Based Pharmacokinetic
PBT	Persistent Bioaccumulation, and Toxic
PECO	Population, Exposure, Comparator, Outcome
PEL	Permissible Exposure Limit
PESO	Pathways/Processes, Exposures, Setting/Scenario, and Outcomes
PESS	Potentially Exposed or Susceptible Subpopulation
PODs	Points of Departure
POTW	Publicly Owned Treatment Works
PPE	Personal Protective Equipment
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals (European Union)
REL	Recommended Exposure Limit
RESO	Receptor, Exposure, Scenario/Setting, and Outcome
RIVM	Dutch National Institute for Public Health and the Environment
RQs	Risk Quotients
SARA	Superfund Amendments and Reauthorization Act
SDS	Safety Data Sheet
SDWA	Safe Drinking Water Act
SNAP	Significant New Alternatives Policy
SRC	SRC Inc., formerly Syracuse Research Corporation
STORET	Storage and Retrieval for Water Quality Data; EPA's repository of water quality monitoring data
TBD	To be determined
TCCR	Transparent, Clear, Consistent and Reasonable
TERA	Toxicology Excellence for Risk Assessment
TIAB	Title and Abstract
TK	Toxicokinetics
TLV	Threshold Limit Value
TMF	Trophic Magnification Factors
TRI	Toxics Release Inventory
TSCA	Toxic Substances Control Act
TTO	Total Toxic Organics
TURA	Toxic Use Reduction Act
TWA	Time-weighted average
UCMR	Unregulated Contaminants Monitoring Rule
UIC	Underground Injection Control
USGS	United States Geological Survey
VP	Vapor Pressure
WHO	World Health Organization
WQX	Water Quality Exchange
WS	Water Solubility
WWT	Wastewater Treatment

EXECUTIVE SUMMARY

In December 2019, EPA designated *trans*-1,2-dichloroethylene (CASRN 156-60-5) as a high priority substance for risk evaluation following the prioritization process as required by Section 6(b) of the Toxic Substances Control Act (TSCA) and implementing regulations (40 CFR Part 702) (Docket ID: EPA-HQ-OPPT-2019-0131). The first step of the risk evaluation process is the development of the draft scope document. EPA published the *Draft Scope of the Risk Evaluation for trans-1,2-Dichloroethylene CASRN 156-60-5* (EPA Document No. EPA-740-D-20-007) (U.S. EPA, 2020d) and provided a 45-day comment period on the draft scope per 40 CFR Part 702.41(c)(7). EPA has considered comments received (Docket ID: EPA-HQ-OPPT-2018-0465) during the public comment period to inform the development of this final scope document, and public comments received will continue to inform the development of the risk evaluation for *trans*-1,2-dichloroethylene. This document fulfills the TSCA requirement to issue a final scope document per TSCA Section 6(b)(4)(D) and as described in 40 CFR 702.41(c)(8). The scope for *trans*-1,2-dichloroethylene includes the following information: the conditions of use, potentially exposed or susceptible subpopulations (PESS), hazards and exposures that EPA plans to consider in this risk evaluation, along with a description of the reasonably available information, conceptual models, analysis plan and science approaches, and plan for peer review for this chemical substance.

General Information. *trans*-1, 2-Dichloroethylene (CASRN 156-60-5) is a highly flammable, colorless liquid with a sharp, harsh odor. It is a synthetic chemical with no known natural sources, and it is used to produce solvents and in chemical mixtures with a total production volume in the United States between 1 and 10 million pounds.

Reasonably Available Information. EPA leveraged the data and information sources already described in the *Proposed Designation of trans-1,2-Dichloroethylene (CASRN 156-60-5) as a High-Priority Substance for Risk Evaluation* (U.S. EPA, 2019d) to inform the development of this scope document. Furthermore, EPA conducted a comprehensive search to identify and screen multiple evidence streams (*i.e.*, chemistry, fate, release and engineering, exposure, hazard) and the search and screening results are provided in Section 2.1. EPA used the systematic review process described in Appendix A to search for and screen reasonably available information, including information already in EPA's possession, for inclusion in the risk evaluation. This information includes the hazards, exposures, PESS, and conditions of use that may help inform the risk evaluation for *trans*-1, 2-dichloroethylene. EPA has focused on the data collection phase (consisting of data search, data screening, and data extraction) during the preparation of the scope document, whereas the data evaluation and integration stages will occur during the development of the risk evaluation and thus are not part of the scoping activities described in this document. EPA will consider additional information identified following publication of this scope document, as appropriate, in developing the risk evaluation, including the Chemical Data Reporting (CDR) information that the Agency will receive by the end of November 2020.

Conditions of Use. EPA plans to evaluate manufacturing (including importing), processing, distribution in commerce, industrial, commercial and consumer uses; and disposal of *trans*-1, 2-dichloroethylene in the risk evaluation. *trans*-1, 2-Dichloroethylene is manufactured (including imported) in the United States. The chemical is processed as a reactant, incorporated into formulation, mixture, or reaction products, and incorporated into articles. The identified processing activities also include the repackaging and recycling of *trans*-1, 2-dichloroethylene. Several industrial and commercial uses were identified that ranged from use as solvent for cleaning and degreasing to use as a component in a refrigerant blend. EPA plans to evaluate the use of *trans*-1,2-dichloroethylene produced as a byproduct from the manufacture of 1,2-dichloroethane (CASRN 107-06-2) in the risk evaluation for 1,2-dichloroethane and

not in the risk evaluation for *trans*-1,2-dichloroethylene. Consumer uses were reported for use in aerosol degreasers, adhesives and sealants and polyurethane foam building insulation. EPA identified these conditions of use from information reported to EPA through CDR and Toxics Release Inventory (TRI) reporting, published literature, public comments, and consultation with stakeholders both for uses currently in production and uses whose production may have ceased. EPA revised the conditions of use in the final scope of the risk evaluation based on additional information and public comments (Docket ID: EPA-HQ-OPPT-2018-0465) on the draft scope document for *trans*-1, 2-dichloroethylene. EPA is aware of information reporting use of *trans*-1,2-dichloroetheylene in pharmaceutical manufacturing; however, they are not conditions of use for the chemical substance as defined in TSCA § 3(2) and (4). Section 2.2 provides details about the conditions of use within the scope of the risk evaluation.

Conceptual Models. The conceptual models for *trans*-1, 2-dichloroethylene are presented in Section 2.6. Conceptual models are graphical depictions of the actual or predicted relationships of conditions of use, exposure pathways (*e.g.*, media), exposure routes (*e.g.*, inhalation, dermal, oral), hazards and receptors throughout the life cycle of the chemical substance. EPA considered reasonably available information as well as public comments received on the draft scope document for *trans*-1,2-dichloroethylene in finalizing the exposure pathways, exposure routes, and hazards EPA plans to evaluate in the risk evaluation. As a result, EPA plans to focus the risk evaluation for *trans*-1,2-dichloroethylene on the following exposures, hazards and receptors:

- *Exposures (Pathways and Routes), Receptors and PESS.* EPA plans to evaluate releases to the environment as well as both human and environmental exposures resulting from the conditions of use of *trans*-1,2-dichloroethylene that EPA plans to consider in risk evaluation. Exposures for *trans*-1,2-dichloroethylene are discussed in Section 2.3. Additional information obtained through the results of systematic review searches will also inform expected exposures.

  EPA's plan for evaluating environmental exposure pathways in the scope of the risk evaluation considers whether and how other EPA-administered statutes and regulatory programs cover *trans*-1,2-dichloroethylene in media pathways falling under the jurisdiction of those authorities. Section 2.6.3.1 discusses pathways under the jurisdiction of other EPA-administered laws. In Section 2.6.3.2, EPA presents the conceptual model describing the identified exposures (pathways and routes), receptors and hazards associated with the conditions of use of *trans*-1,2-dichloroethylene within the scope of the risk evaluation.

  EPA considered reasonably available information and comments received on the draft scope for *trans*-1,2-dichloroethylene in determining the human and environmental exposure pathways, routes, receptors and PESS for inclusion in the final scope. EPA plans to evaluate the following human and environmental exposure pathways, routes, receptors and PESS in the scope of the risk evaluation:

  - *Occupational exposure:* EPA plans to evaluate exposure to workers and occupational non-users (ONUs) via the inhalation route and exposure to workers via the dermal route associated with manufacturing, processing, industrial/commercial use, and disposal of *trans*-1,2-dichloroethylene.
  - *Consumer and bystander exposure:* EPA plans to evaluate inhalation exposure to consumers and bystanders, and dermal exposure to *trans*-1,2-dichloroethylene for consumers during use of adhesives and sealants, aerosol degreaser products, and polyurethane foam building insulation.

- *General population exposure:* EPA plans to evaluate general population exposure to *trans*-1,2-dichloroethylene via inhalation of ambient air.
- *PESS:* EPA plans to evaluate children, women of reproductive age (*e.g.*, pregnant women), workers, and consumers as PESS in the risk evaluation.
- *Environmental exposure:* EPA plans to evaluate exposure to *trans*-1,2-dichloroethylene for aquatic and terrestrial receptors.

- *Hazards.* Hazards for *trans*-1,2-dichloroethylene are discussed in Section 2.4. EPA completed preliminary reviews of information (*e.g.*, federal and international government chemical assessments) to identify potential environmental and human health hazards for *trans*-1,2-dichloroethylene as part of the prioritization (U.S. EPA, 2019d) and scoping process (U.S. EPA, 2020d). EPA also considered reasonably available information collected through systematic review methods as outlined in Appendix A and public comments received on the draft scope for *trans*-1,2-dichloroethylene in determining the broad categories of environmental and human health hazard effects to be evaluated in the risk evaluation. EPA will use systematic review methods to evaluate the epidemiological and toxicological literature for *trans*-1,2-dichloroethylene.

  EPA plans to evaluate all potential environmental and human health hazard effects identified for *trans*-1,2- dichloroethylene in Sections 2.4.1 and 2.4.2, respectively. Identified through the data screening phase of systematic review, the potential environmental hazard effects and related information that EPA plans to consider for the risk evaluation include: cardiovascular, musculoskeletal, and reproductive for *trans*-1,2-dichloroethylene. Similarly, the potential human health hazard effects and related information identified through prioritization and the data screening phase ofsystematic review for *trans*-1,2- dichloroethylene that EPA plans to consider for the risk evaluation include: ADME, cancer, cardiovascular, developmental, endocrine, gastrointestinal, hematological and immune, hepatic, musculoskeletal, neurological, nutritional and metabolic, ocular and sensory, renal, reproductive, respiratory and skin and connective tissue.

Analysis Plan. The analysis plan for *trans*-1,2-dichloroethylene is presented in Section 2.7. The analysis plan outlines the general science approaches that EPA plans to use for the various evidence streams (*i.e.*, chemistry, fate, release and engineering, exposure, hazard) supporting the risk evaluation. The analysis plan is based on EPA's knowledge of *trans*-1,2-dichloroethylene to date which includes a review of identified information as described in Section 2.1. Should additional data or approaches become reasonably available, EPA may consider them for the risk evaluation.

Peer Review. The draft risk evaluation for *trans*-1,2-dichloroethylene will be peer reviewed. Peer review will be conducted in accordance with relevant and applicable methods for chemical risk evaluations, including using EPA's Peer Review Handbook (U.S. EPA, 2015) and other methods consistent with Section 26 of TSCA (see 40 CFR 702.45).

1 INTRODUCTION

This document presents the scope of the risk evaluation to be conducted for *trans*-1,2-dichloroethylene under the Frank R. Lautenberg Chemical Safety for the 21st Century Act. The Frank R. Lautenberg Chemical Safety for the 21st Century Act amended TSCA on June 22, 2016. The new law includes statutory requirements and deadlines for actions related to conducting risk evaluations of existing chemicals.

Under TSCA § 6(b), the Environmental Protection Agency (EPA) must designate chemical substances as high-priority substances for risk evaluation or low-priority substances for which risk evaluations are not warranted at the time, and upon designating a chemical substance as a high-priority substance, initiate a risk evaluation on the substance. TSCA § 6(b)(4) directs EPA to conduct risk evaluations for existing chemicals, to "*determine whether a chemical substance presents an unreasonable risk of injury to health or the environment, without consideration of costs or other nonrisk factors, including an unreasonable risk to a potentially exposed or susceptible subpopulation identified as relevant to the risk evaluation by the Administrator under the conditions of use*."

TSCA § 6(b)(4)(D) and implementing regulations require that EPA publish the scope of the risk evaluation to be conducted, including the hazards, exposures, conditions of use and PESS that the Administrator expects to consider, within 6 months after the initiation of a risk evaluation. In addition, a draft scope is to be published pursuant to 40 CFR 702.41. In December 2019, EPA published a list of 20 chemical substances that have been designated high priority substances for risk evaluations (Docket ID: EPA-HQ-OPPT-2019-0131) (84 FR 71924, December 30, 2019), as required by TSCA § 6(b)(2)(B), which initiated the risk evaluation process for those chemical substances. *trans*-1,2-Dichloroethylene is one of the chemicals designated as a high priority substance for risk evaluation. On April 9, 2020, EPA published the *Draft Scope of the Risk Evaluation for trans-1,2-Dichloroethylene* (EPA Document No. 740-D-20-007) (85 FR 19941, April 9, 2020) (U.S. EPA, 2020d) for a 45-day public comment period. After reviewing and considering the public comments (Docket ID: EPA-HQ-OPPT-2018-0465) received on the draft scope document, EPA is now publishing this final scope document pursuant to 40 CFR 702.41(c)(8).

2 SCOPE OF THE EVALUATION

2.1 Reasonably Available Information

EPA conducted a comprehensive search for reasonably available information[1] to support the development of this scope document for *trans*-1,2-dichloroethylene. EPA leveraged the data and information sources already collected in the documents supporting the chemical substance's high-priority substance designations. In addition, EPA searched for additional data and information on physical and chemical properties, environmental fate, engineering, exposure, environmental and human health hazards that could be obtained from the following general categories of sources:

1. Databases containing publicly available, peer-reviewed literature;
2. Gray literature, which is defined as the broad category of data/information sources not found in standard, peer-reviewed literature databases;

[1] *Reasonably available information* means information that EPA possesses or can reasonably generate, obtain, and synthesize for use in risk evaluations, considering the deadlines specified in TSCA Section 6(b)(4)(G) for completing such evaluation. Information that meets the terms of the preceding sentence is reasonably available information whether or not the information is confidential business information, that is protected from public disclosure under TSCA Section 14 (40 CFR 702.33).

3. Data and information submitted under TSCA Sections 4, 5, 8(e), and 8(d), as well as "for your information" (FYI) submissions.

Following the comprehensive search, EPA performed a title and abstract screening to identify information potentially relevant for the risk evaluation process. This step also classified the references into useful categories or tags to facilitate the sorting of information through the systematic review process.

Search terms were used to search each of the literature streams and gather *trans*-1,2-dichloroethylene studies. These terms and the methods used to develop them are listed in Appendix A. The studies resulting from the search process were loaded into the EPA Health and Environmental Research Online (HERO) database and then prioritized to screen first the literature likely relevant for each of the disciplines: fate, physical and chemical properties, engineering, exposure and hazard. The tools and methods used to manage the screening process are also outlined in Appendix A. The studies resulting from the search underwent a title/abstract screening process, which tagged them by topic or category. Following this, a determination was made to move studies forward into full-text screening. The criteria used in the screening process for each discipline are found in the population, exposure, comparator, outcome (PECO) statements listed in Appendix A. The screening process results are presented in the form of literature inventory trees and evidence tables in Section 2.1.2. The screening process was conducted based on EPA's general expectations for the planning, execution and assessment activities outlined in the Appendix A.

EPA has focused on the data collection phase (consisting of data search, data screening, and data extraction) during the preparation of the scope document, whereas the data evaluation and integration stages will occur during the development of the risk evaluation and thus are not part of the scoping activities described in this document.

The subsequent sections summarize the data collection activities completed to date for the general categories of sources and topic areas (or disciplines) using systematic review methods.

2.1.1 Search of Gray Literature

EPA surveyed the gray literature[2] and identified 114 search results relevant to EPA's risk evaluation needs for *trans*-1,2- dichloroethylene. Appendix A.3.4 lists the gray literature sources that yielded 114 discrete data or information sources relevant to *trans*-1,2-dichloroethylene. EPA further categorized the data and information into the various topic areas (or disciplines) supporting the risk evaluation (*e.g.*, physical and chemical properties, environmental fate, ecological hazard, human health hazard, exposure, engineering), and the breakdown is shown in Figure 2-1. EPA will consider additional reasonably available information from gray literature if it becomes available during the risk evaluation phase.

[2] Gray literature is defined as the broad category of data/information sources not found in standard, peer-reviewed literature databases (*e.g.*, PubMed and Web of Science). Gray literature includes data/information sources such as white papers, conference proceedings, technical reports, reference books, dissertations, information on various stakeholder websites and other databases.

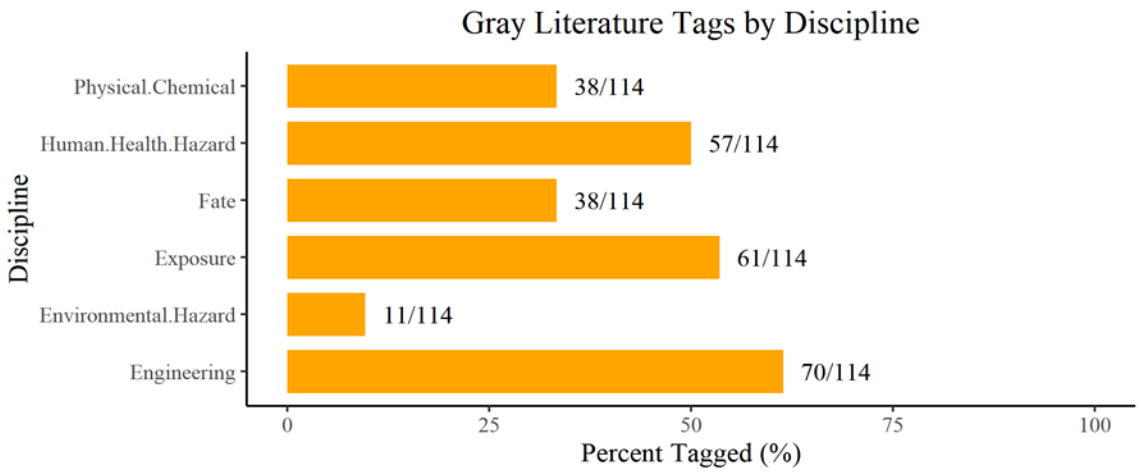

Figure 2-1. Gray Literature Tags by Discipline for *trans*-1,2-Dichloroethylene
The percentages across disciplines do not add up to 100%, as each source may provide data or information for various topic areas (or disciplines).

2.1.2 Search of Literature from Publicly Available Databases (Peer-reviewed Literature)

EPA has begun the systematic review process and has conducted searching and screening of the reasonably available literature using the process outlined in Appendix A. This includes performing a comprehensive search of the reasonably available peer review literature on physical and chemical properties, environmental fate and transport, engineering (environmental release and occupational exposure), exposure (environmental, general population and consumer) and environmental and human health hazards of *trans*-1,2-dichloroethylene. Eligibility criteria were applied in the form of PECO statements. Included references met the PECO criteria, whereas excluded references did not meet the criteria (*i.e.*, not relevant), and supplemental material was considered as potentially relevant (see Appendix A.2). EPA plans to evaluate the reasonably available information identified for each discipline during the development of the risk evaluation.

EPA created literature inventory trees to graphically illustrate the flow of data and information sources following full-text screening (see Figure 2-2, Figure 2-3, Figure 2-5, Figure 2-7, and Figure 2-9). EPA used the Health Assessment Workplace Collaborative (HAWC) tool to develop web-based literature inventory trees illustrating, through interactive links, studies that were included or excluded. These literature inventory trees enhance the transparency of the decisions resulting from the screening process described in Appendix A. For each of the corresponding disciplines, the literature was tagged to be included for evaluation during the risk evaluation. Literature inventory trees for physical and chemical properties are provided as static diagrams (Figure 2-2). For all other disciplines, static screen captures are provided in addition to links to the interactive trees. The links show individual studies that were tagged as included, excluded or supplemental. Supplemental studies did not meet all inclusion criteria but may be considered during risk evaluation as supporting information (see Appendix A). These studies can be accessed through the hyperlink provided in the associated caption below each figure. In some figures the sum of the numbers for the various sub-categories may be larger than the broader category because some studies may be included under multiple sub-categories. In other cases, the sum of the various sub-categories may be smaller than the main category because some studies may not be depicted in the sub-categories if their relevance to the risk evaluation was unclear.

In addition, EPA tabulated the number and characteristics of the data and information sources included in the full-text screening process in the form of literature heat maps for the fate, engineering, exposure and hazard information (see Figure 2-4, Figure 2-6, Figure 2-8, Figure 2-10). For each of these four disciplines, a static image of the literature inventory heat map is provided and a link to Interactive version presented in HAWC is included in the caption below each diagram.

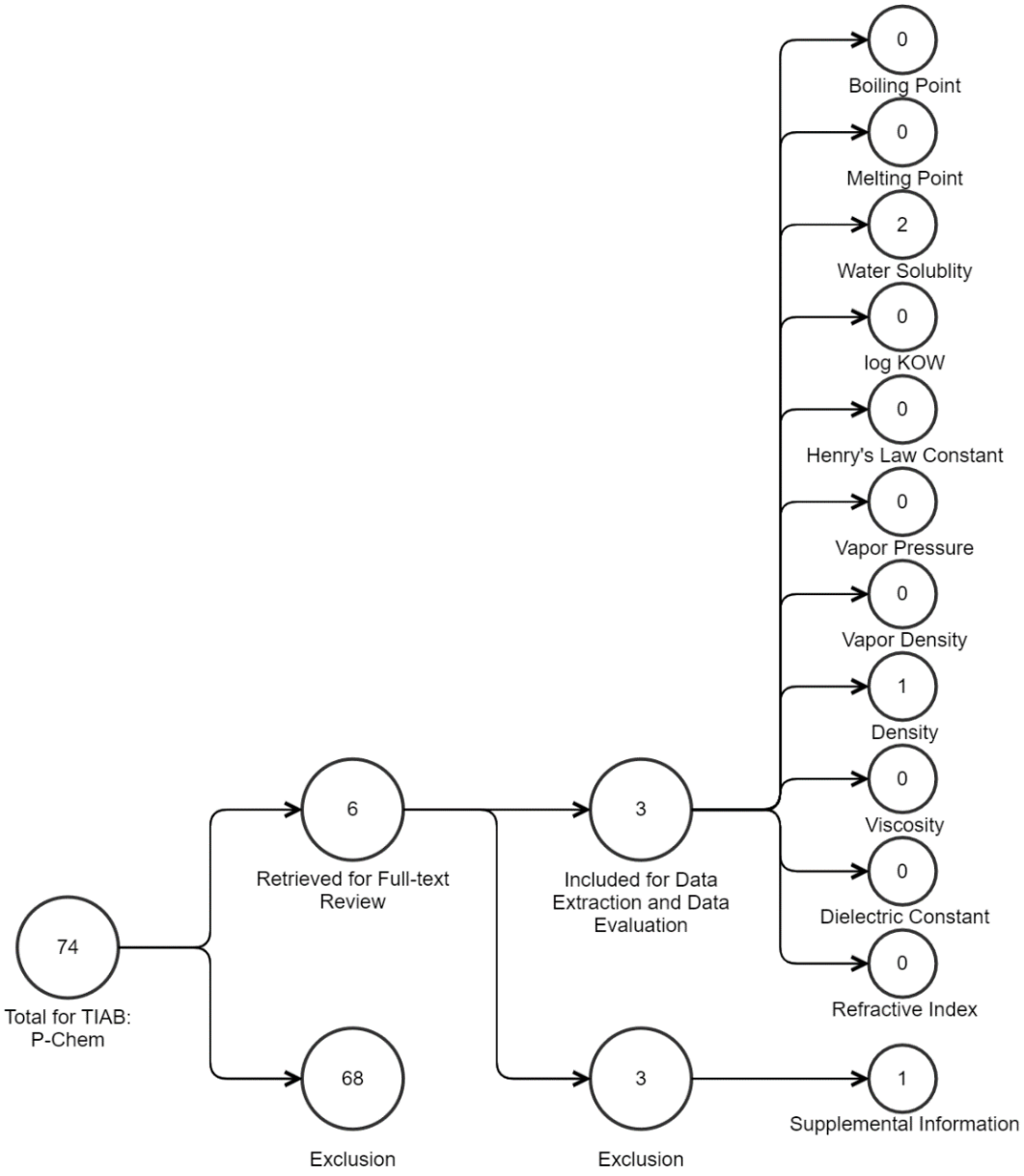

Figure 2-2. Peer-Reviewed Literature Inventory Tree - Physical and chemical Properties Search Results for *trans*-1,2-Dichloroethylene

Data in this static figure represent references obtained from the publicly available databases search (see Appendix A.1.2) that were included during full-text screening as of June 2, 2020. TIAB refers to "title and abstract" screening.

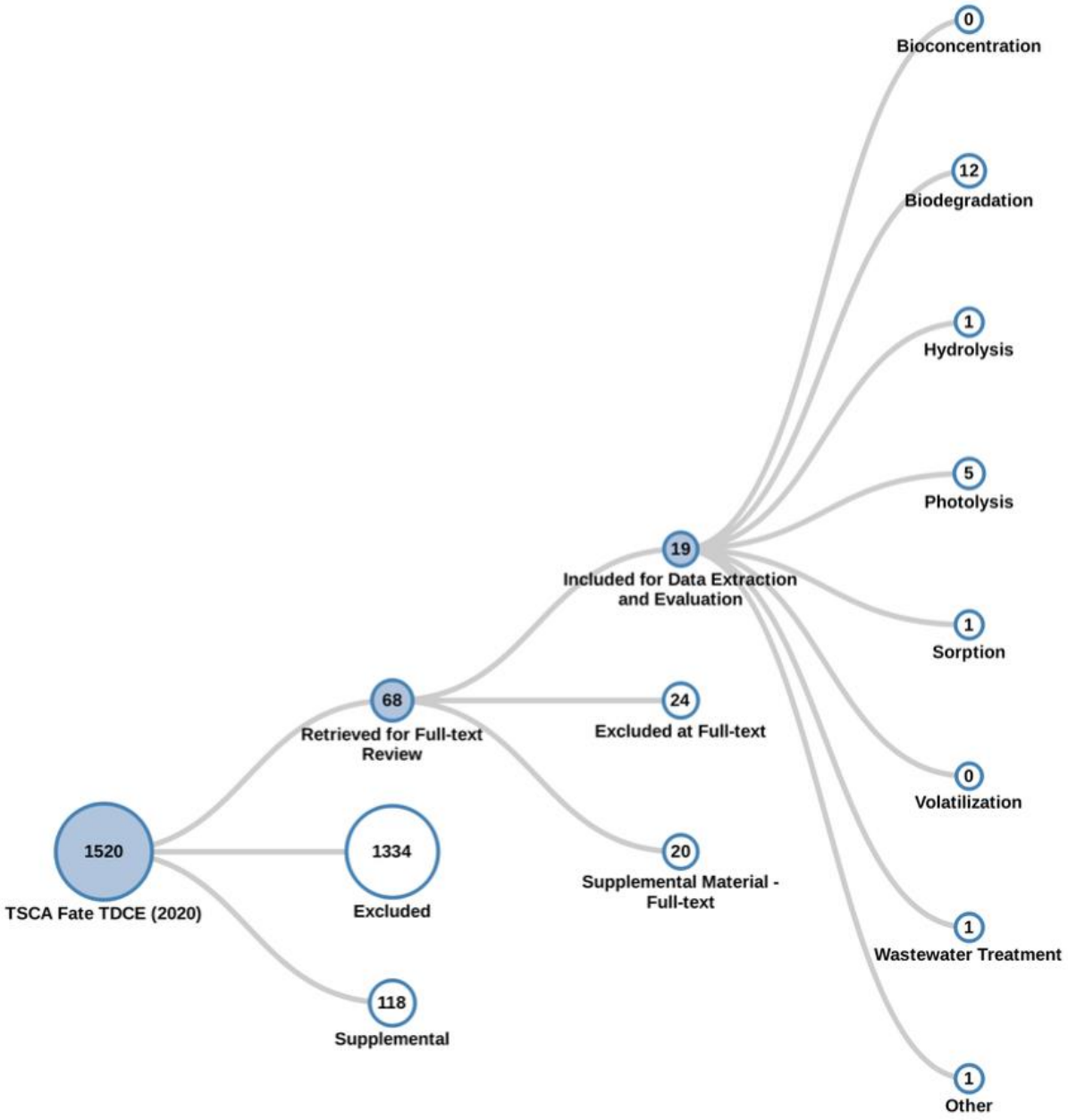

Figure 2-3 Peer-reviewed Literature Inventory Tree – Fate and Transport Search Results for *trans*-1,2-Dichloroethylene

Click here to view the interactive literature inventory tree. Data in this figure represent references obtained from the publicly available databases search (see Appendix A.1.2) that were included during full-text screening as of June 2, 2020. Additional data may be added to the interactive version as they become available.

	Media					
Endpoint	Air	Soil, Sediment	Wastewater, Biosolids	Water	Other	Grand Total
Bioconcentration						
Biodegradation		7	1	8		12
Hydrolysis				1		1
Photolysis	4	1		2		5
Sorption		1				1
Volatilization						
Wastewater Treatment		1		1		1
Other		1				1
Grand Total	4	10	2	11		20

Figure 2-4 Peer-reviewed Literature Inventory Heat Map – Fate and Transport Search Results for *trans*-1,2-Dichloroethylene

Click here to view the interactive version for additional study details. The column totals, row totals, and grand totals indicate total numbers of unique references, as some references may be included in multiple cells. The various shades of color visually represent the amount of relevant references identified by media or endpoint. The darker the color, the more references are available for a given media or endpoint. Data in this figure represents references obtained from the publicly available databases search (see Section A.1.2) that were included during full-text screening as of June 2, 2020. Additional data may be added to the interactive version as they become available.

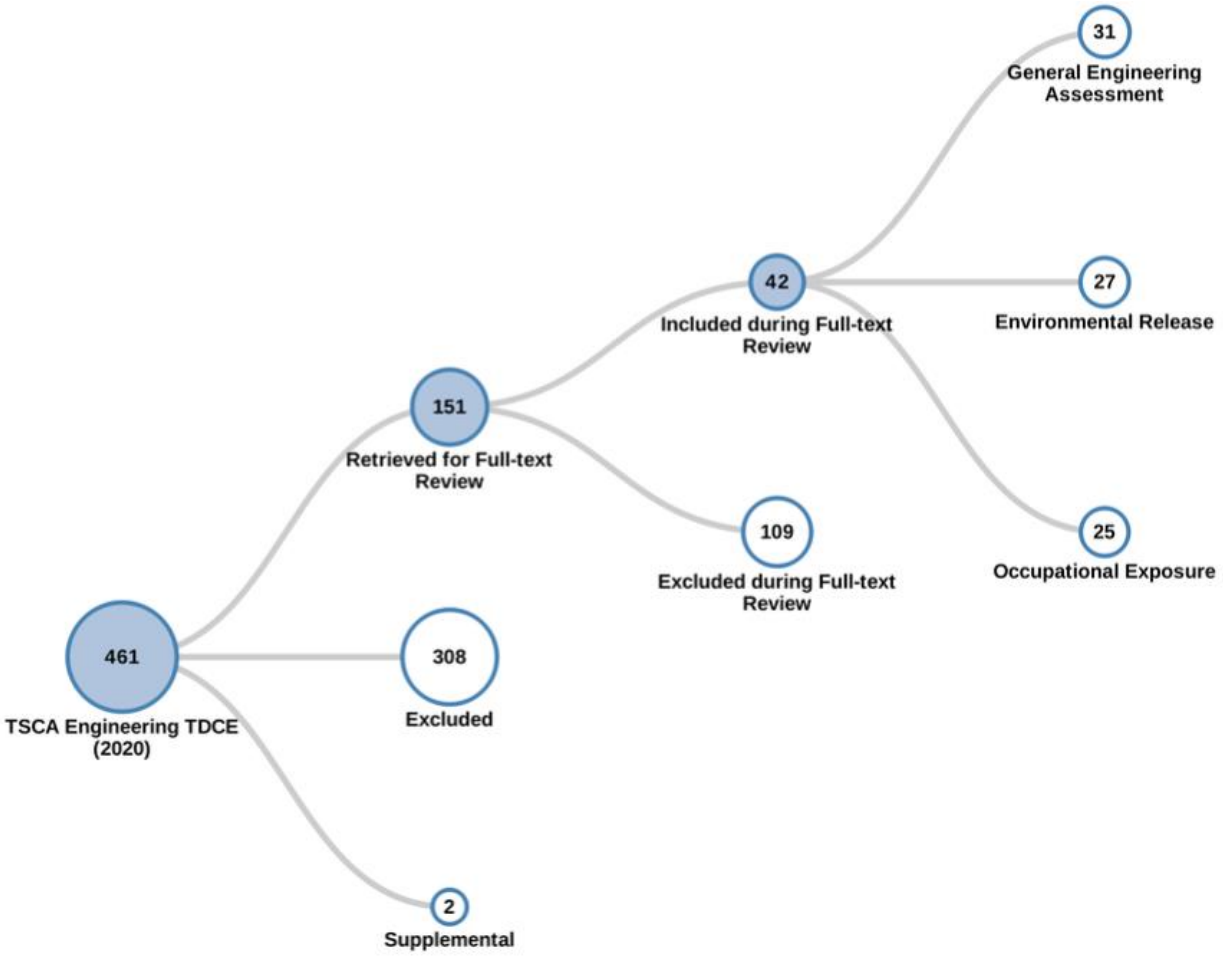

Figure 2-5 Peer-Reviewed Literature Inventory Tree - Engineering Search Results for *trans*-1,2-Dichloroethylene

Click here to view the interactive literature inventory tree. Data in this figure represent references obtained from the publicly available databases search (see Appendix A.1.2) that were included during full-text screening as of August 5, 2020. Additional data may be added to the interactive version as they become available.

Data Type	Evidence Tags	
Environmental Releases	Description of release source	17
	No evidence tag	1
	Release frequency	4
	Release or emission factors	15
	Release quantity	8
	Waste treatment methods and pollution control	9
	Total	27
General Engineering Assessment	Chemical concentration	8
	Life cycle description	6
	No evidence tag	6
	Number of sites	7
	Process description	18
	Production, import, or use volume	11
	Throughput	6
	Total	31
Occupational Exposures	Area sampling data	2
	Dermal exposure data	5
	Engineering control	3
	Exposure duration	5
	Exposure frequency	4
	Exposure route	13
	No evidence tag	6
	Number of workers	8
	Particle size characterization	
	Personal protective equipment	7
	Personal sampling data	
	Physical form	11
	Worker activity description	11
	Total	25
Grand Total		42

Figure 2-6 Peer-reviewed Literature Inventory Heat Map – Engineering Search Results for *trans*-1,2-Dichloroethylene

Click here to view the interactive version for additional study details. Data in this static figure represent references obtained from the publicly available databases search (see Appendix A.1.2) that were included during full-text screening as of August 5, 2020. Additional data may be added to the interactive version as they become available.

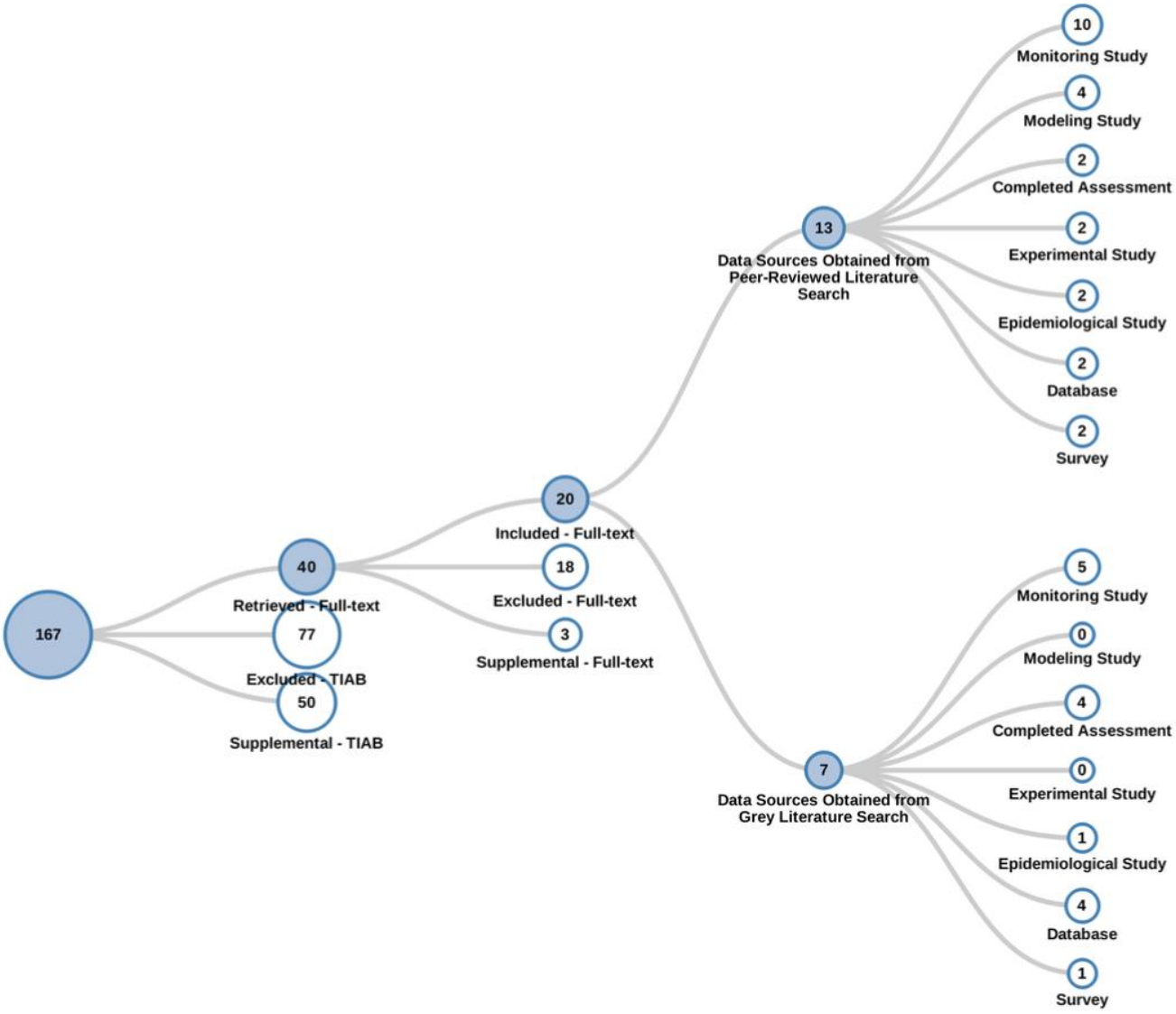

Figure 2-7 Peer-Reviewed and Gray Literature Inventory Tree - Exposure Search Results for *trans*-1,2-Dichloroethylene

Click here to view the interactive literature inventory tree. Data in this figure represent all references obtained from the publicly available databases search (see Appendix A.1.2), and gray literature references search (see Appendix A.3) that were included during full-text screening as of July 31, 2020. Additional data may be added to the interactive version as they become available.

Media (group)	Data Type: Monitoring Study	Modeling Study	Completed Assessment	Experimental Study	Epidemiological Study	Database	Survey	Grand Total
Ambient Air	7	2	2	1	1	2	2	9
Biosolids/Sludge								
Drinking Water								
Groundwater								
Land Disposal/ Landfill								
Sediment			1					1
Soil	1		2					2
Surface Water	1		2			1		3
Wastewater			1					1
Aquatic Species								
Terrestrial Species								
Consumer				1				1
Dietary	1	1	2	1		1	1	3
Dust								
Exposure Factors								
Exposure Pathway	3		1			1	2	3
Human Biomonitoring	4		1		2	2		4
Indoor Air	6	1	2	1			1	7
Isomers	6	3	2	1	2	3	1	10
Use Information			1					1
No Evidence Type								
Grand Total	15	4	6	2	3	6	3	20

Figure 2-8 Peer-reviewed and Gray Literature Inventory Heat Map –Exposure Search Results for *trans*-1,2-Dichloroethylene

Click here to view the interactive version for additional study details. The column totals, row totals, and grand totals indicate total numbers of unique references only, as some references may be included in multiple cells. The various shades of color visually represent the number of relevant references identified by exposure media or data type. The darker the color, the more references are available for a given exposure media or data type. Data in this figure represent all references obtained from the publicly available databases search (see Appendix A.1.2), and gray literature references search (see Appendix A.3) that were included during full-text screening as of July 31, 2020. Additional data may be added to the interactive version as they become available.

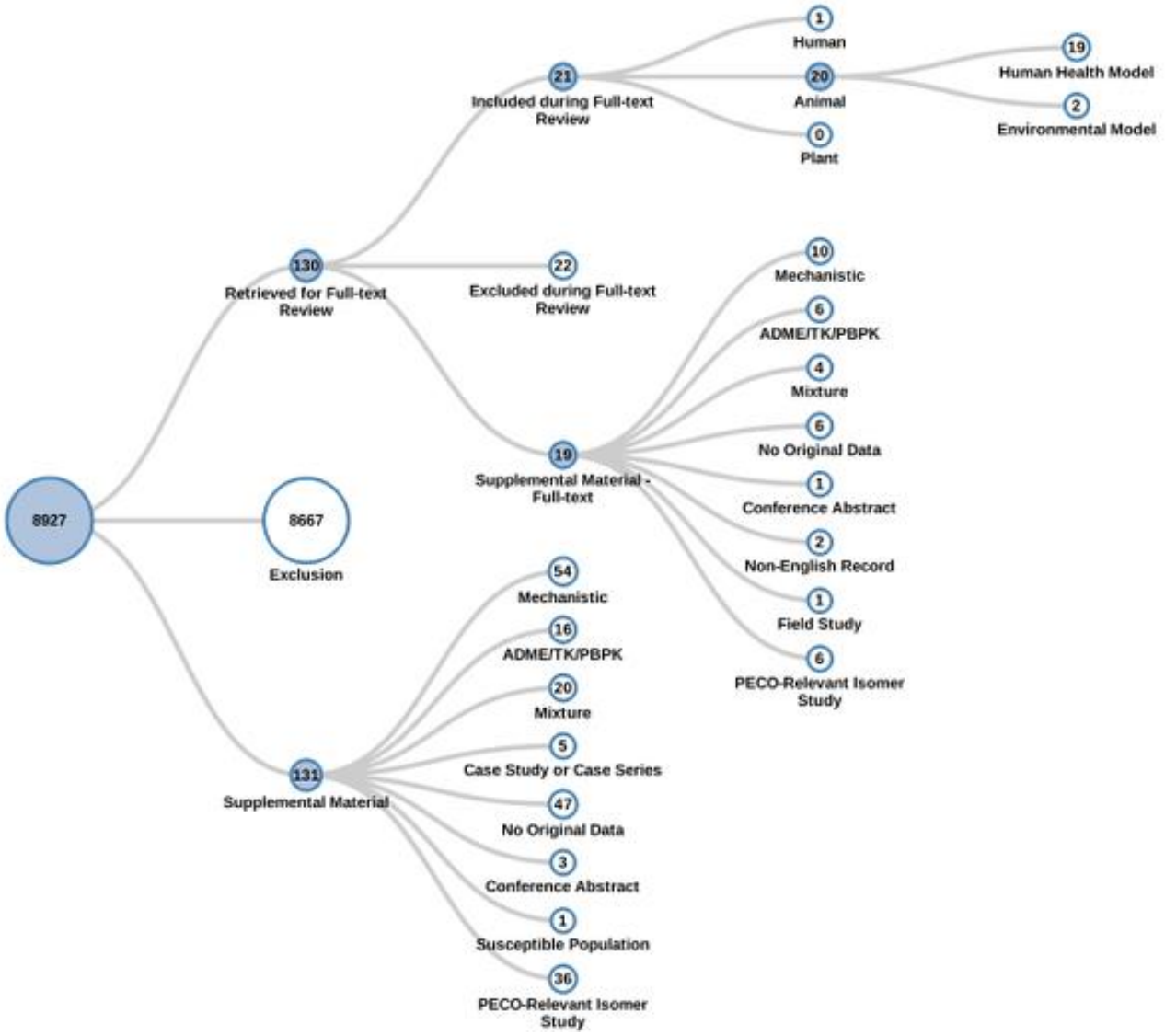

Figure 2-9. Peer-reviewed Literature Inventory Tree - Human Health and Environmental Hazards Search Results for *trans*-1,2-Dichloroethylene

Click here to view the interactive literature inventory tree. Data in this figure represent references obtained from the publicly available databases search (see Appendix A.1.2) that were included during full-text screening as of June 2, 2020. Additional data may be added to the interactive version as they become available.

	Evidence Type				
Health Outcomes	Human	Animal - Human Health Model	Animal - Environmental Model	Plant	Grand Total
ADME	1	3			4
Cancer	1	1			2
Cardiovascular		1	1		1
Developmental		2			2
Endocrine		1			1
Gastrointestinal		2			2
Hematological and Immune		7			7
Hepatic		7			7
Mortality					
Musculoskeletal	1	1	1		3
Neurological		5			5
Nutritional and Metabolic		1			1
Ocular and Sensory		5			5
PBPK					
Renal		5			5
Reproductive	1	4	1		5
Respiratory		3			3
Skin and Connective Tissue	1	1			2
No Tag		2			2
Grand Total	1	19	2		21

Figure 2-10. Peer-reviewed Literature Inventory Heat Map – Human Health and Environmental Hazards Search Results for *trans*-1,2-Dichloroethylene

Click here to view the interactive version for additional study details. The numbers indicate the number of studies with TIAB keywords related to a particular health outcome, not the number of studies that observed an association with *trans*-1,2-dichloroethylene. Evidence types were manually extracted, and Health Systems were determined via machine learning. Therefore, the studies examining multiple Health Outcomes and Evidence types, connections between health outcome, and evidence type may not be accurately represented. If a study evaluated multiple health outcomes or included multiple populations or study designs, it is shown here multiple times. Data in this figure represents references obtained from the publicly available databases search (see Appendix A.1.2) that were included during full-text screening as of June 2, 2020. Additional data may be added to the interactive version as they become available.

2.1.3 Search of TSCA Submissions

Table 2-1 presents the results of screening the titles of data sources and reports submitted to EPA under various sections of TSCA. EPA screened a total of 63 submissions using PECO or similar statements that identify inclusion/exclusion criteria specific to individual disciplines (see Table 2-1 for the list of disciplines). The details about the criteria are presented in Appendix A.2.1. EPA identified 60 submissions that met the inclusion criteria in these statements and identified 2 submissions with

supplemental data.[3] EPA excluded one submission because the report was identified as an environmental impact statement for proposed equipment.

Table 2-1. Results of Title Screening of Submissions to EPA under Various Sections of TSCA [a]

Discipline	Included	Supplemental [b]
Physical and Chemical Properties	0	0
Environmental Fate and Transport	3	0
Environmental and General Population Exposure	57	0
Occupational Exposure/Release Information	3	0
Environmental Hazard	0	0
Human Health Hazard	1	2

[a] Individual submissions may be relevant to multiple disciplines.
[b] Included submissions may contain supplemental data for other disciplines, which will be identified at full-text review.

2.2 Conditions of Use

As described in the *Proposed Designation of trans-1,2-Dichloroethylene (CASRN 156-60-5) as a High-Priority Substance for Risk Evaluation* (U.S. EPA, 2019d), EPA assembled information from the CDR and TRI programs to determine conditions of use[4] or significant changes in conditions of use of the chemical substance. As described in the *Proposed Designation of trans-1,2-dichloroethylene (CASRN 156-60-5) as a High-Priority Substance for Risk Evaluation* (U.S. EPA, 2019d), EPA assembled information from the CDR and TRI programs to determine conditions of use[5] or significant changes in conditions of use of the chemical substance. Once the 2020 CDR reporting period ends in November 2020, EPA will utilize the most recent CDR information. EPA also consulted a variety of other sources to identify uses of *trans*-1,2-dichloroethylene, including published literature, company websites, and government and commercial trade databases and publications. To identify formulated products containing *trans*-1,2-dichloroethylene, EPA searched for safety data sheets (SDS) using internet searches; EPA Chemical and Product Categories (CPCat) (U.S. EPA, 2019c) data; and other resources in which SDSs could be found. SDSs were cross-checked with company websites to make sure that each product SDS was current. In addition, EPA incorporated communications with companies, industry groups, and public comments to supplement the use information.

EPA identified and described the categories and subcategories of conditions of use that EPA plans to include in the scope of the risk evaluation (Section 2.2.1; Table 2-2). The conditions of use that EPA plans to include in the scope are those reflected in the life cycle diagrams and conceptual models.

[3] EPA may further consider some supplemental or excluded references depending on the reasons for tagging as supplemental or excluded.
[4] *Conditions of use* means the circumstances, as determined by the Administrator, under which a chemical substance is intended, known, or reasonably foreseen to be manufactured, processed, distributed in commerce, used, or disposed of (TSCA § 3(4)).
[5] *Conditions of use* means the circumstances, as determined by the Administrator, under which a chemical substance is intended, known, or reasonably foreseen to be manufactured, processed, distributed in commerce, used, or disposed of (TSCA § 3(4)).

After gathering reasonably available information related to the manufacture, processing, distribution in commerce, use, and disposal of *trans*-1,2-dichloroethylene, EPA identified those activities for *trans*-1,2-dichloroethylene the Agency determined not to be conditions of use or will otherwise be excluded during scoping. These excluded activities are described in Section 2.2.2.

2.2.1 Categories and Subcategories of Conditions of Use Included in the Scope of the Risk Evaluation

Table 2-2 lists the conditions of use that EPA plans to include in the scope of the risk evaluation.

Table 2-2. Categories and Subcategories of Conditions of Use Included in the Scope of the Risk Evaluation

Life-Cycle Stage[a]	Category[b]	Subcategory[c]	Reference
Manufacturing	Domestic manufacture	Domestic Manufacture	U.S. EPA (2019b)
Manufacturing	Import	Import	U.S. EPA (2019b)
Processing	Processing as a reactant	Plating agents and surface treating agents	U.S. EPA (2019b)
Processing	Processing as a reactant	Intermediate in chemical product and preparation manufacturing	Dreher et al. (2014), Axiall (2016)
Processing	Processing – incorporation into formulation, mixture or reaction product	Solvents (for cleaning or degreasing)	U.S. EPA (2019b)
Processing	Processing – incorporation into formulation, mixture or reaction product	Solvents (which become part of product formulation or mixture)	U.S. EPA (2019b)
Processing	Processing – incorporation into formulation, mixture or reaction product	Adhesives and sealant chemicals	Wilsonart (2017)
Processing	Processing – incorporation into formulation, mixture or reaction product	Foam blowing additive	Axiall (2016)
Processing	Processing – incorporation into formulation, mixture or reaction product	Carrier solvent in adhesives, coatings, inks, lubricants, and silicones.	EPA-HQ-OPPT-2018-0465-0009
Processing	Incorporation into articles	Propellant and blowing agent in plastics product manufacturing; flexible	U.S. EPA (2019b)

Life-Cycle Stage[a]	Category[b]	Subcategory[c]	Reference
		polyurethane foam manufacturing	
Processing	Repackaging	Repackaging	U.S. EPA (2019b)
Processing	Recycling	Recycling	U.S. EPA (2019b)
Distribution in commerce	Distribution in commerce	Distribution in commerce	
Industrial/commercial use	Solvents (for cleaning or degreasing)	Vapor degreaser	EPA-HQ-OPPT-2018-0465-0006
Industrial/commercial use	Solvents (for cleaning or degreasing)	Aerosol spray cleaner/degreaser	EPA-HQ-OPPT-2018-0465-0003; EPA-HQ-OPPT-2018-0465-0006; EPA-HQ-OPPT-2018-0465-0009
Industrial/commercial use[d]	Solvents (for cleaning or degreasing)	Non-aerosol cleaner/degreaser	EPA-HQ-OPPT-2018-0465-0031
Industrial/commercial use	Solvents (for cleaning or degreasing)	Flux remover (liquid and aerosol)	ACL Incorporated (2016)
Industrial/commercial use	Cleaning and furnishing care products	Spot cleaner; stain remover	U.S. EPA (2019b), Albatross USA Inc. (2017)
Industrial/commercial use	Functional fluids (open systems)	Smoothing fluid in additive manufacturing	MicroCare (2018)
Industrial/commercial use	Anti-adhesive agent	Mold release	EPA-HQ-OPPT-2018-0465-0006, Belzona (2017)
Industrial/commercial use	Solvents (which become part of product formulation or mixture)	Urethane coatings	Miller-Stephenson Chemical (2016a, 2016b)
Industrial/commercial use	Lubricants and greases	Liquid and spray lubricants and greases, and penetrating lubricants	EPA-HQ-OPPT-2018-0465-0006
Industrial/commercial use	Adhesives and sealants	Solvent-based adhesives and sealants; Adhesive accelerant	Wilsonart (2017), Permabond Engineering Adhesives (2018)
Industrial/commercial use	Functional fluids (closed systems)	Refrigerant	U.S. EPA (2016)

Life-Cycle Stage[a]	Category[b]	Subcategory[c]	Reference
Industrial/commercial use	Processing aids	Extraction solvent for thermoplastics	Dreher et al. (2014)
Industrial/commercial use	Other uses	Laboratory chemicals	Thermo Fisher Scientific (2018)
Commercial use	Propellants and blowing agents	Polyurethane foam building insulation	(Demilec Inc, 2017a); 2017b), Covestro LLC (2016)
Commercial Use	Solvents (for cleaning or degreasing)	Refrigerant flush	ACE (2015)
Consumer use	Solvents (for cleaning or degreasing)	Aerosol degreaser	CRC Industries Inc (2017)
Consumer use	Propellants and blowing agents	Polyurethane foam building insulation	Demilec Inc (2017a, 2017b), Covestro LLC (2016)
Consumer use	Adhesives and sealants	Adhesive accelerant	Permabond Engineering Adhesives (2018)
Disposal	Disposal	Disposal	

[a] Life Cycle Stage Use Definitions (40 CFR § 711.3)
- "Industrial use" means use at a site at which one or more chemicals or mixtures are manufactured (including imported) or processed.
- "Commercial use" means the use of a chemical or a mixture containing a chemical (including as part of an article) in a commercial enterprise providing saleable goods or services.
- "Consumer use" means the use of a chemical or a mixture containing a chemical (including as part of an article, such as furniture or clothing) when sold to or made available to consumers for their use. Although EPA has identified both industrial and commercial uses here for purposes of distinguishing scenarios in this document, the Agency interprets the authority over "any manner or method of commercial use" under TSCA Section 6(a)(5) to reach both.

[b] These categories of conditions of use appear in the Life Cycle Diagram, reflect CDR codes, and broadly represent conditions of use of *trans*-1, 2-dichloroethylene in industrial and/or commercial settings and for consumer uses.

[c] These subcategories reflect more specific conditions of use of *trans*-1, 2-dichloroethylene.

- In the draft scope of the risk evaluation, a condition of use was included for Industrial/commercial use for *trans*-1,2-dichloroethylene as a functional fluid in pharmaceutical and medicine manufacturing. EPA has determined that the use of *trans*-1,2-dichloroethylene in medical devices and pharmaceutical manufacturing falls outside TSCA's definition of a "chemical substance." (See Section 2.2.2).

- In the final scope, EPA made the following change to the conditions of use:
- The industrial/commercial condition of use for "Solvents (for cleaning or degreasing) - Non-aerosol cleaner/degreaser" was added based on comment EPA-HQ-OPPT-2018-0465-0031.
- The consumer condition of use for cleaning and furnishing care product spot cleaner; stain remover was removed from the condition of use table in the final scope document because additional research determined this product is not available through consumer channels and not conducive to consumer purchase or use EPA-HQ-OPPT-2018-0465-0040.

2.2.2 Activities Excluded from the Scope of the Risk Evaluation

As explained in the final rule *for Procedures for Chemical Risk Evaluation Under the Amended Toxic Substances Control Act (82 FR 33726, July 20, 2017)*, TSCA Section 6(b)(4)(D) requires EPA to identify the hazards, exposures, conditions of use, and the PESS the Administrator expects to consider in a risk evaluation, suggesting that EPA may exclude certain activities that it determines to be conditions of use on a case-by-case basis. (82 FR 33736, 33729; July 20, 2017). TSCA Section 3(4) also grants EPA discretion to determine the circumstances that are appropriately considered to be conditions of use for a particular chemical substance[6]. As a result, EPA does not plan to include in this scope or in the risk evaluation activities described below that the Agency does not consider to be conditions of use or for which EPA is exercising discretionary authority provided by TSCA Section 6(b)(4)(D).

TSCA Section 3(2) also excludes from the definition of "chemical substance" "any food, food additive, drug, cosmetic, or device (as such terms are defined in Section 201 of the Federal Food, Drug, and Cosmetic Act [21 U.S.C. 321]) when manufactured, processed, or distributed in commerce for use as a food, food additive, drug, cosmetic, or device" as well as "any pesticide (as defined in the Federal Insecticide, Fungicide, and Rodenticide Act [7 U.S.C. 136 et seq.]) when manufactured, processed, or distributed in commerce for use as a pesticide." EPA has determined that the following uses of *trans*-1,2-dichloroethylene are non-TSCA uses:

While use of *trans*-1,2-dichloroethylene as a functional fluid in a closed system during pharmaceutical manufacturing was included in the draft scope (EPA-HQ-OPPT-2018-0465-0026), upon further analysis of the details of this process, EPA has determined that this use falls outside TSCA's definition of 'chemical substance.' Under TSCA § 3(2)(B)(vi), the definition of "chemical substance" does not include any food, food additive, drug, cosmetic, or device (as such terms are defined in Section 201 of the Federal Food, Drug, and Cosmetic Act) when manufactured, processed, or distributed in commerce for use as a food, food additive, drug, cosmetic, or device. EPA has found that *trans*-1,2-dichloroethylene use as a functional fluid in a closed system during pharmaceutical manufacturing entails use as an extraction solvent in the purification of pharmaceutical products, and has concluded that this use falls within the aforementioned definitional exclusion and is not a "chemical substance" under TSCA. Activities and releases associated with pharmaceutical manufacturing use are therefore not "conditions of use" (defined as circumstances associated with "a chemical substance," TSCA § 3(4)) and will not be evaluated during risk evaluation.

2.2.3 Production Volume

As reported to EPA during the 2016 CDR submission period and described here as a range to protect production volumes that were claimed as confidential business information (CBI), total production volume of *trans*-1,2-dichloroethylene in 2015 was between 1 million and 10 million pounds (U.S. EPA, 2020a). EPA also uses pre-2015 CDR production volume information, as detailed in the *Proposed*

[6] *Chemical substance* means any organic or inorganic substance of a particular molecular identity, including any combination of such substances occurring in whole or in part as a result of a chemical reaction or occurring in nature, and any element or uncombined radical. Chemical substance does not include (1) any mixture; (2) any pesticide (as defined in the Federal Insecticide, Fungicide, and Rodenticide Act) when manufactured, processed, or distributed in commerce for use as a pesticide; (3) tobacco or any tobacco product; (4) any source material, special nuclear material, or byproduct material (as such terms are defined in the Atomic Energy Act of 1954 and regulations issued under such Act); (5) any article the sale of which is subject to the tax imposed by Section 4181 of the Internal Revenue Code of 1954 (determined without regard to any exemptions from such tax provided by Section 4182 or 4221 or any other provision of such Code), and; (6) any food, food additive, drug, cosmetic, or device (as such terms are defined in Section 201 of the Federal Food, Drug, and Cosmetic Act) when manufactured, processed, or distributed in commerce for use as a food, food additive, drug, cosmetic, or device (TSCA § 3(2)).

Designation of trans-1,2-Dichloroethylene (CASRN 156-60-5) as a High-Priority Substance for Risk Evaluation (U.S. EPA, 2019d) and will include more recent production volume information from the 2020 CDR reporting period in the risk evaluation to support the exposure assessment.

2.2.4 Overview of Conditions of Use and Lifecycle Diagram

Figure 2-11 provides the lifecycle diagram for *trans*-1,2-dichloroethylene. The life cycle diagram is a graphical representation of the various life stages of the industrial, commercial and consumer use categories included within the scope of the risk evaluation. The information in the life cycle diagram is grouped according to the CDR processing codes and use categories (including functional use codes for industrial uses and product categories for industrial, commercial and consumer uses). Appendix E contains additional descriptions (*e.g.*, process descriptions, worker activities, process flow diagrams) for each manufacture, processing, distribution in commerce, use and disposal category.

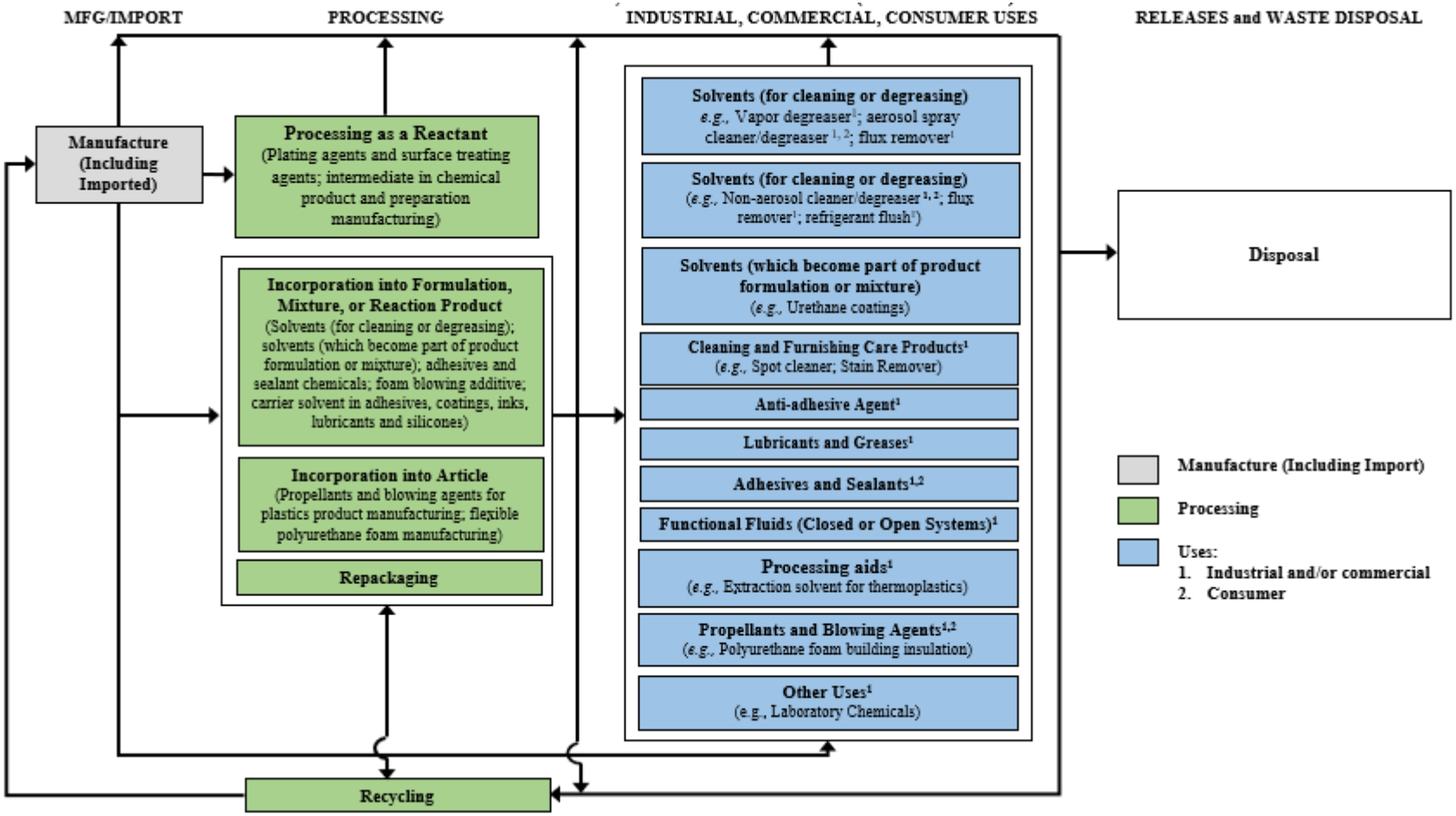
MFG/IMPORT
PROCESSING
INDUSTRIAL, COMMERCIAL, CONSUMER USES
RELEASES and WASTE DISPOSAL
Manufacture (Including Imported)
Processing as a Reactant (Plating agents and surface treating agents; intermediate in chemical product and preparation manufacturing)
Incorporation into Formulation, Mixture, or Reaction Product (Solvents (for cleaning or degreasing); solvents (which become part of product formulation or mixture); adhesives and sealant chemicals; foam blowing additive; carrier solvent in adhesives, coatings, inks, lubricants and silicones)
Incorporation into Article (Propellants and blowing agents for plastics product manufacturing; flexible polyurethane foam manufacturing)
Repackaging
Recycling
Solvents (for cleaning or degreasing) e.g., Vapor degreaser[1]; aerosol spray cleaner/degreaser [1, 2]; flux remover[1]
Solvents (for cleaning or degreasing) (e.g., Non-aerosol cleaner/degreaser [1, 2]; flux remover[1]; refrigerant flush[1])
Solvents (which become part of product formulation or mixture) (e.g., Urethane coatings)
Cleaning and Furnishing Care Products[1] (e.g., Spot cleaner; Stain Remover)
Anti-adhesive Agent[1]
Lubricants and Greases[1]
Adhesives and Sealants[1,2]
Functional Fluids (Closed or Open Systems)[1]
Processing aids[1] (e.g., Extraction solvent for thermoplastics)
Propellants and Blowing Agents[1,2] (e.g., Polyurethane foam building insulation)
Other Uses[1] (e.g., Laboratory Chemicals)
Disposal
Manufacture (Including Import)
Processing
Uses:
1. Industrial and/or commercial
2. Consumer

Figure 2-11. *trans*-1,2-Dichloroethylene Life Cycle Diagram

2.3 Exposures

For TSCA exposure assessments, EPA plans to analyze human and environmental exposures and releases to the environment resulting from the conditions of use within the scope of the risk evaluation for *trans*-1,2-dichloroethylene. In this section, the physical and chemical properties, environmental fate and transport properties and releases to the environment are described in addition to potential human and environmental exposures from TSCA conditions of use and from other possible or known sources. Release pathways and routes will be described in Section 2.6 to characterize the relationship or connection between the conditions of use of the chemical and the exposure to human receptors, including PESS and environmental receptors. EPA plans to consider, where relevant, the duration, intensity (concentration), frequency and number of exposures in characterizing exposures to *trans*-1,2-dichloroethylene.

2.3.1 Physical and Chemical Properties

Consideration of physical and chemical properties is essential for a thorough understanding or prediction of environmental fate (*i.e.*, transport and transformation) and the eventual environmental concentrations. It can also inform the hazard assessment. Table 2-3 summarizes the physical and chemical property values preliminarily selected for use in the risk evaluation from among the range of reported values collected as of June 2020. This table differs from that presented in the *Proposed Designation of trans-1,2-Dichloroethylene (CASRN 156-60-5) as a High-Priority Substance for Risk Evaluation* (U.S. EPA, 2019d) and may be updated as EPA continues to evaluate and integrate additional information through systematic review methods. Figure 2-12 summarizes the distribution of reported values for eight physical and chemical properties routinely used in existing chemical risk evaluations. Appendix B presents summary statistics for reported physical and chemical property values. All physical and chemical property values that were extracted and evaluated as of June 2020 are presented in the supplemental file *Data Extraction and Data Evaluation Tables for Physical and Chemical Property Studies* (EPA-HQ-OPPT-2018-0465).

Table 2-3. Physical and Chemical Properties of *trans*-1,2-Dichloroethylene

Property or Endpoint	Value[a]	Reference	Data Quality Rating
Molecular formula	$C_2H_2Cl_2$	NA	NA
Molecular weight	96.94 g/mol	NA	NA
Physical state	Liquid	Rumble (2018)	High
Physical properties	Colorless, light liquid, sweetish scent	NLM (2018)	High
Melting point	-49.8°C	Rumble (2018)	High
Boiling point	47.64°C	Rumble (2018)	High
Density	1.2565 g/cm^3 at 20°C	O'Neil (2013)	High
Vapor pressure	331 mm Hg at 25°C	NLM (2018)	High
Vapor density	3.67 at 47.64°C (at bp at 760 mm Hg)	NLM (2018)	High

Property or Endpoint	Value[a]	Reference	Data Quality Rating
Water solubility	5,300 mg/L at 25°C	Rumble (2018)	High
Octanol/water partition coefficient (Log Kow)	2.09	O'Neil (2013)	High
Henry's Law constant	9.47×10^{-3} atm·m^3/mol at 25°C	Rumble (2018)	High
Flash point	Not available		
Auto flammability	Not available		
Viscosity	0.317 cP at 25°C	Rumble (2018)	High
Refractive index	1.4454	Rumble (2018)	High
Dielectric constant	2.35	Elsevier (2019)	High

[a] Measured unless otherwise noted.
NA = Not applicable

Figure 2-12 displays a summary of the data collected as of June 2020 for eight physical and chemical values routinely used in TSCA existing chemical risk evaluations. The box and whisker plots for each endpoint illustrate the mean (average, indicated by the blue diamond) and the 10^{th}, 25^{th}, 50^{th} (median), 75^{th}, and 90^{th} percentiles. All individual data points are indicated by black squares, and value preliminarily selected for use in the risk evaluation is overlaid (indicated by the orange circle) to provide context for where it lies within the distribution of the dataset. The number of unique primary data sources is indicated below each box and whisker plot. If multiple sources presented equivalent values and cited the same primary source, only one of those was included in the statistical calculations. As a result, the number of sources listed in Figure 2-12 may differ from the total number of data sources presented in Figure 2-2. Where no data could be identified through systematic review, text appears to clearly demonstrate the gap for the endpoint.

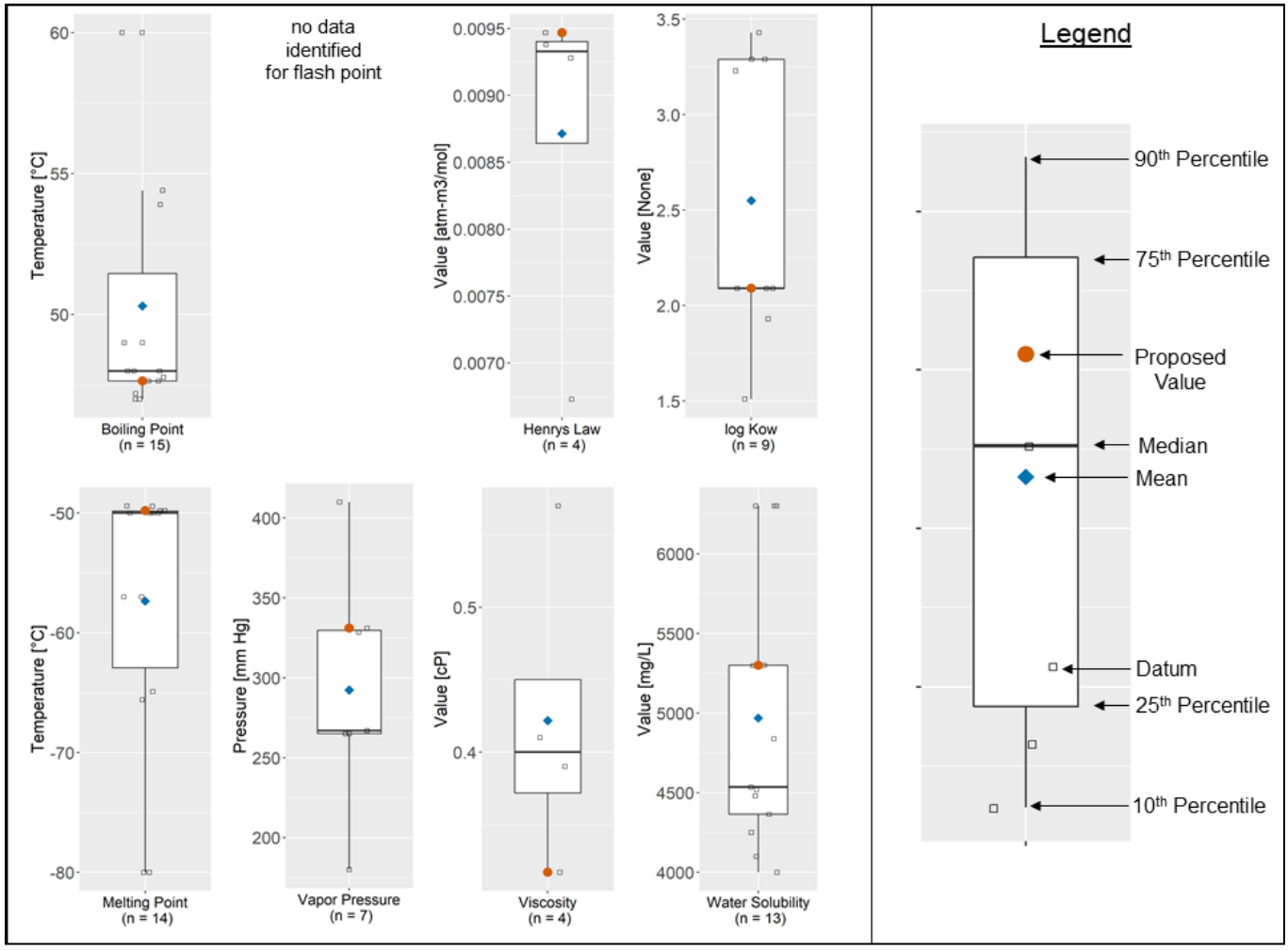

Figure 2-12. Box and Whisker Plots of Reported Physical and Chemical Property Values

2.3.2 Environmental Fate and Transport

Understanding of environmental fate and transport processes assists in the determination of the specific exposure pathways and potential human and environmental receptors that need to be assessed in the risk evaluation for *trans*-1,2-dichloroethylene. EPA plans to use the environmental fate characteristics described in Table 5 of the *Proposed Designation of trans-1,2-Dichloroethylene (CASRN 156-60-5) as a High-Priority Substance for Risk Evaluation* (U.S. EPA, 2019d) to support the development of the risk evaluation for *trans*-1,2-dichloroethylene. The values for the environmental fate properties (Appendix C) may be updated as EPA evaluates and integrates additional information into the risk evaluation through systematic review methods.

2.3.3 Releases to the Environment

Releases to the environment from conditions of use are a component of potential exposure and may be derived from reported data that are obtained through direct measurement, calculations based on empirical data and/or assumptions and models.

A source of information that EPA plans to consider in evaluating exposure are data reported to the TRI program. EPA's TRI database contains information on chemical waste management activities that are disclosed by industrial and federal facilities, including quantities released into the environment (*i.e.*, to

air, water, and land), treated, burned for energy recovery, recycled, or transferred off-site to other facilities for these purposes.

Under Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA) 1,2-dichloroethylene (CASRN 540-59-0) is a TRI-reportable substance effective as of January 01, 1987 (40 CFR 372.65). For TRI reporting[7], facilities in covered sectors in the United States are required to disclose releases and other waste management quantities of 1,2-dichloroethylene as CASRN 540-59-0 if they manufacture (including import) or process more than 25,000 pounds or otherwise use more than 10,000 pounds of the chemical in a given year by July 1 of the following year.

Facilities reporting 1,2-dichloroethylene releases and waste management quantities are not required to differentiate between the *cis*- and *trans*- isomers; as such there is no way to differentiate between the isomers from reported TRI data. However, since the relative percentages of commercial forms of 1,2-dichloroethylene tend to be 60% *cis*- isomer:40% *trans*-isomer, one can roughly estimate the specific quantities of each isomer that comprise mass quantities reported to TRI for 1,2-dichloroethylene.

Table 2-4 provides production-related waste management data for 1,2-dichloroethylene (two isomers or mixture of two) reported by facilities to EPA for reporting year 2018[8]. As shown in the table, 18 facilities reported a total of nearly 10 million pounds of 1,2-dichloroethylene waste managed. Nearly 90% of the total production-related waste quantities reported for the chemical was treated. Compared to the other waste management quantities reported, very little of 1,2-dichloroethylene (less than 0.13%) was disposed of or otherwise released to the environment during 2018.

Table 2-4. Summary of 1,2-Dichloroethylene Production-Related Waste Managed in 2018

Year	Number of Facilities	Recycled (lbs)	Recovered for Energy (lbs)	Treated (lbs)	Released (lbs) [a,b,c]	Total Production Related Waste (lbs)
2018	18	421,620	590,821	8,934,334	12,611	9,959,385

Data source: U.S. EPA (2018)

[a] Terminology used in these columns may not match the more detailed data element names used in the TRI public data and analysis access points.
[b] Does not include releases due to one-time event not associated with production such as remedial actions or earthquakes.
[c] Counts all releases including release quantities transferred and release quantities disposed of by a receiving facility reporting to TRI.

Table 2-5 provides a summary of the quantities of 1,2-dichloroethylene released or disposed of to the environment during 2018. There were zero pounds reported as released to water via surface water discharges, and a total of 9,477 pounds released to air, mostly as fugitive emissions. Very little of 1,2-dichloroethylene was disposed of to land. The 3,102 pounds classified as "other releases" were sent off site to waste brokers for disposal, accounting for roughly ¼ of total releases.

[7] For TRI reporting criteria see https://www.epa.gov/toxics-release-inventory-tri-program/basics-tri-reporting
[8] Reporting year 2018 is the most recent TRI data available. Data presented in Table 2-4 were queried using TRI Explorer and uses the 2018 National Analysis data set (released to the public in November 2019). This dataset includes revisions for the years 1988 to 2018 processed by EPA.

Table 2-5. Summary of Releases of 1,2-Dichloroethylene to the Environment During 2018

	Number of Facilities	Air Releases		Water Releases (lbs)	Land Disposal			Other Releases (lbs)[a]	Total Releases (lbs) [b, c]
		Stack Air Releases (lbs)	Fugitive Air Releases (lbs)		Class I Under-ground Injection (lbs)	RCRA Subtitle C Landfills (lbs)	All other Land Disposal (lbs)[a]		
Totals	18	1,806	7,671	0	4	3	24	3,102	12,611
		9,477			31				

Data source: U.S. EPA (2018)
[a] Terminology used in these columns may not match the more detailed data element names used in the TRI public data and analysis access points.
[b] These release quantities do include releases due to one-time events not associated with production such as remedial actions or earthquakes.
[c] Counts release quantities once at final disposition, accounting for transfers to other TRI reporting facilities that ultimately dispose of the chemical waste.

While production-related waste managed shown in Table 2-4 excludes any quantities reported as catastrophic or one-time releases (TRI Form R, Section 8 data), release quantities shown in Table 2-5 include both production-related and non-production-related quantities for 2018. In the case of 1,2-dichloroethylene the total release quantities shown in the two tables are the same, but for other TRI chemicals they may differ slightly and may further reflect differences in TRI calculation methods for reported release range estimates (U.S. EPA, 2017).

EPA plans to review these data in conducting the exposure assessment component of the risk evaluation for *trans*-1,2-dichloroethylene.

2.3.4 Environmental Exposures

The manufacturing, processing, distribution, use and disposal of *trans*-1,2-dichloroethylene can result in releases to the environment and exposure to aquatic and terrestrial receptors (biota). Environmental exposures to biota are informed by releases into the environment, overall persistence, degradation, and bioaccumulation, and partitioning across different media. Concentrations of chemical substances in biota provide evidence of exposure. EPA plans to review available environmental exposure data in biota in the risk evaluation.

Monitoring data were identified in EPA's data search for *trans*-1,2-dichloroethylene and can be used in the exposure assessment. Relevant and reliable monitoring studies provide(s) information that can be used in an exposure assessment. Monitoring studies that measure environmental concentrations or concentrations of chemical substances in biota provide evidence of exposure.

EPA plans to review available environmental monitoring data in the risk evaluation. USGS's Monitoring Data – National Water Quality Monitoring Council has identified *trans*-1,2-dichloroethylene in air, ground water, sediment, soil, surface water and biota (*e.g.*, fish tissue concentrations) (USGS, 1991a, b, c, d, e, f, g). In the United States, the California Environmental Protection Agency (CalEPA) has measured *trans*-1,2-dichloroethylene in surface water at levels of 0.43–1,307 ppb and in groundwater at levels of 0.25–500,000 ppb (CalEPA, 2006). A source of *trans*-1,2-dichloroethylene is anaerobic biodegradation of chlorinated solvents, and these are present at detectable levels in landfill gases (ATSDR, 1996). Disposal and leaching of chlorinated solvent waste may lead to levels of *trans*-1,2-dichloroethylene in soil and sediment via the migration of *trans*-1,2-dichloroethylene from groundwater.

2.3.5 Occupational Exposures

EPA plans to evaluate worker activities where there is a potential for exposure under the various conditions of use (manufacturing, processing, industrial/commercial uses, and disposal) described in Section 2.2. In addition, EPA plans to evaluate exposure to occupational non-users (ONUs), *i.e.*, workers who do not directly handle the chemical but perform work in an area where the chemical is present. EPA also plans to consider the effect(s) that engineering controls (EC) and/or personal protective equipment (PPE) have on occupational exposure levels as part of the risk evaluation.

Examples of worker activities associated with the conditions of use within the scope of the risk evaluation for *trans*-1, 2-dichloroethylene that EPA may analyze include, but are not limited to:

- Unloading and transferring *trans*-1,2-dichloroethylene to and from storage containers to process vessels;
- Handling and disposing of waste containing *trans*-1,2-dichloroethylene;
- Cleaning and maintaining equipment;
- Sampling chemicals, formulations or products containing *trans*-1,2-dichloroethylene for quality control;
- Repackaging chemicals, formulations or products containing *trans*-1,2-dichloroethylene;
- Performing other work activities in or near areas where *trans*-1,2-dichloroethylene is used.

trans-1,2-Dichloroethylene has a vapor pressure of 331 mmHg at 25°C (see Appendix B), hence, inhalation exposure is a significant route of exposure for workers and occupational non-users (ONUs) in occupational exposure scenarios where *trans*-1,2-dichloroethylene is used and handled in open systems or where there is potential for mist generation. The extent of exposure could vary from facility to facility depending on many factors including but not limited to EC, type of facility, and facility design. *trans*-1,2-Dichloroethylene has an Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) of 200 ppm or 790 mg/m^3 over an 8-hour workday, time weighted average (TWA). The American Conference of Governmental Industrial Hygienists (ACGIH) sets the Threshold Limit Value (TLV) at 200 ppm TWA (OSHA, 2009). This chemical also has a National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limit (REL) of 200 ppm (790 mg/m^3) TWA (NIOSH, 2019).

EPA plans to analyze worker exposure to liquids via the dermal route. EPA does not plan to analyze dermal exposure for occupational non-users because they do not directly handle *trans*-1,2-dichloroethylene.

EPA generally does not evaluate occupational exposures through the oral route. Workers and ONUs may inadvertently ingest inhaled particles that deposit in the upper respiratory tract. In addition, workers may transfer chemicals from their hands to their mouths. The frequency and significance of this exposure route are dependent on several factors including the physical and chemical properties of the substance during worker activities, the visibility of the chemicals on the hands while working, workplace training and practices, and personal hygiene that is difficult to predict (Cherrie et al., 2006). EPA will consider the relevance of this exposure route on a case-by-case basis, taking into consideration the aforementioned factors and any reasonably available information, and may assess oral exposure for workers for certain COUs and worker activities where warranted.

2.3.6 Consumer Exposures

No conditions of use information for *trans*-1,2-dichloroethylene was found in the 2012 or 2016 CDR. One material safety data sheet indicated that *trans*-1,2-dichloroethylene issued as a solvent for cleaning and or degreasing, particularly as an aerosol degreaser (CRC Industries Inc, 2017). Additional

conditions of use include adhesives and sealants which may be solvent-based or adhesive accelerants (Permabond Engineering Adhesives, 2018). Off-gassing of *trans*-1,2-dichloroethylene from polyurethane foam and building insulation is a potential source of exposure to *trans*-1,2-dichloroethylene. In addition, the Consumer Product Database [CPDat (U.S. EPA, 2019a)] indicated that *trans*-1,2-dichloroethylene is used as a consumer product in in cleaners, propellants, and solvents. These uses can result in exposures to consumers and bystanders.

Consumers using or disposing of aerosol degreasing products, or adhesives and sealants, may be exposed to *trans*-1,2-dichloroethylene through direct liquid contact which may lead to a dermal exposure. In addition, due to its high volatility at room temperature *trans*-1,2-dichloroethylene may expose consumers via a vapor pathway which may lead to inhalation exposure. Bystanders present during the consumer use or disposal of solvents used for cleaning and or degreasing, adhesives and sealants, or polyurethane foam building insulation, may also be exposed to *trans*-1,2-dichloroethylene via vapors leading to inhalation exposures. The vapor to inhalation exposure route is particularly noteworthy for *trans*-1,2-dichloroethylene as known products are supplied as aerosols.

2.3.7 General Population Exposures

Releases of *trans*-1,2-dichloroethylene from certain conditions of use, such as manufacturing, disposal, or waste treatment activities, may result in general population exposures via drinking water ingestion, dermal contact, and inhalation from air releases. The general population that lives in urban areas may be exposed to low levels (0.013-0.076 ppb) of *trans*-1,2-dichloroethylene via air (ATSDR, 1996). In addition, the general population may also be exposed to low levels of *trans*-1,2-dichloroethylene in U.S. drinking water supplies. Community systems that rely on groundwater supplies may have a higher possibility of exposure to *trans*-1,2-dichloroethylene (ATSDR, 1996). There is a lack of available data to quantify general population exposure to *trans*-1,2-dichloroethylene by oral and dermal routes (ATSDR 2016, (CalEPA, 2006).

The OECD monitoring database has identified human biomonitoring data for *trans*-1,2-dichloroethylene (OECD, 2018). However, blood concentrations of *trans*-1,2-dichloroethylene were below the limit of detection in 2,754 individuals who participated in the National Health and Nutrition Examination Survey (NHANES) 2011-2012 subsample of the U.S. population (CDC, 2018). The general population pathways in the scope of this evaluation are described in Sections 2.6.3 and 2.7.2.5.

2.4 Hazards (Effects)

2.4.1 Environmental Hazards

EPA considered reasonably available information (*e.g.*, federal and international government chemical assessments) on *trans*-1,2-dichloroethylene as well as public comments received on the *Proposed Designation of trans-1,2-Dichloroethylene (CASRN 156-60-5) as a High-Priority Substance for Risk Evaluation* (U.S. EPA, 2019d) and draft scope for *trans*-1,2-dichloroethylene (U.S. EPA, 2020d) to identify potential environmental hazards. (U.S. EPA, 2019d) and draft scope for *trans*-1,2-dichloroethylene to identify potential environmental hazards. During prioritization EPA identified environmental hazard effects for aquatic and terrestrial organisms.

Since prioritization, EPA applied automated techniques during the data screening phase of systematic review to identify the following potential environmental hazards and related information that may be considered for the risk evaluation (as explained in Appendix A): cardiovascular, musculoskeletal, and reproductive (Figure 2-10). A summary of the references identified during the screening step of systematic review is included in the interactive literature inventory trees (Figure 2-9). As EPA continues

to evaluate reasonably available and relevant hazard information identified through systematic review, EPA may update the list of potential environmental hazard effects to be analyzed in the risk evaluation.

2.4.2 Human Health Hazards

EPA considered reasonably available information (*e.g.*, federal and international government chemical assessments) on trans-1,2-dichloroethylene as well as public comments on the *Proposed Designation of trans-1,2-Dichloroethylene (CASRN 156-60-5) as a High-Priority Substance for Risk Evaluation* (U.S. EPA, 2019d) and draft scope for trans-1,2-dichloroethylene (U.S. EPA, 2020d) to identify potential human health hazards. (U.S. EPA, 2019d) and the draft scope for trans-1,2-dichloroethylene to identify potential human health hazards. During prioritization, EPA identified the following potential human health hazards and related information: acute toxicity, irritation/corrosion, genetic toxicity, repeated dose toxicity and immunotoxicity.

Since prioritization, EPA applied automated techniques during the data screening phase of systematic review to identify the following additional potential human health hazards and related information that may be considered for the risk evaluation (as explained in Appendix A): ADME, cancer, cardiovascular, developmental, endocrine, gastrointestinal, hepatic, musculoskeletal, neurological, nutritional and metabolic, ocular and sensory, renal, reproductive, respiratory and skin and connective tissue (Figure 2-10). A summary of the references identified through the screening step of systematic review is included in the interactive literature inventory trees (Figure 2-9). As EPA continues to evaluate reasonably available and relevant hazard information identified through systematic review, EPA may update the list of potential human health hazard effects to be analyzed in the risk evaluation.

2.5 Potentially Exposed or Susceptible Subpopulations

TSCA requires EPA to determine whether a chemical substance presents an unreasonable risk to "a potentially exposed or susceptible subpopulation identified as relevant to the risk evaluation." TSCA §3(12) states that "*the term 'potentially exposed or susceptible subpopulation' means a group of individuals within the general population identified by the Administrator who, due to either greater susceptibility or greater exposure, may be at greater risk than the general population for adverse health effects from exposure to a chemical substance or mixture, such as infants, children, pregnant women, workers, or the elderly.*" General population is "the total of individuals inhabiting an area or making up a whole group" and refers here to the U.S. general population (U.S. EPA, 2011a).

EPA identified the following PESS based on CDR information and studies reporting developmental and reproductive effects: women of reproductive age (*e.g.*, pregnant women), workers, including ONUs and users and consumers, including users and bystanders (U.S. EPA, 2019b). EPA plans to evaluate these PESS in the risk evaluation. Following further evaluation of the reasonably available information, EPA may evaluate PESS in the general population as they relate to fence line communities.

In developing exposure scenarios, EPA plans to analyze reasonably available data to ascertain whether some human receptor groups may be exposed via exposure pathways that may be distinct to a particular subpopulation or life stage (*e.g.*, children's crawling, mouthing or hand-to-mouth behaviors) and whether some human receptor groups may have higher exposure via identified pathways of exposure due to unique characteristics (*e.g.*, activities, duration or location of exposure) when compared with the general population (U.S. EPA, 2006b). Likewise, EPA plans to evaluate available human health hazard information to ascertain whether some human receptor groups may have greater susceptibility than the general population to the chemical's hazard(s). Based on these analyses, EPA may update the list of PESS in the risk evaluation.

2.6 Conceptual Models

In this section, EPA presents the conceptual models describing the identified exposures (pathways and routes), receptors and hazards associated with the conditions of use of *trans*-1,2-dichloroethylene. Pathways and routes of exposure associated with workers and ONUs are described in Section 2.6.1, and pathways and routes of exposure associated with consumers are described in Section 2.6.2. Pathways and routes of exposure associated with environmental releases and wastes, including those pathways that are under the jurisdiction of other EPA-administered laws, are discussed and depicted in the conceptual model shown in Section 2.6.3.1. Pathways and routes of exposure associated with environmental releases and wastes, excluding those pathways that are under the jurisdiction of other EPA-administered laws, are presented in the conceptual model shown in Section 2.6.3.2.

2.6.1 Conceptual Model for Industrial and Commercial Activities and Uses

Figure 2-13 illustrates the conceptual model for the pathways of exposure from industrial and commercial activities and uses of *trans*-1,2-dichloroethylene that EPA plans to include in the risk evaluation. There is potential for exposures to workers and ONUs via inhalation routes and exposures to workers via dermal routes. It is expected that inhalation exposure to vapors is the most likely exposure route. In addition, workers at waste management facilities may be exposed via inhalation or dermal routes from wastewater treatment, incineration or via other disposal methods. EPA plans to evaluate activities resulting in exposures associated with distribution in commerce (*e.g.*, loading, unloading) throughout the various lifecycle stages and conditions of use (*e.g.*, manufacturing, processing, industrial use, commercial use, and disposal) rather than a single distribution scenario.

For each condition of use identified in Table 2-2, a determination was made as to whether or not EPA plans to evaluate each combination of exposure pathway, route, and receptor in the risk evaluation. The results of that analysis along with the supporting rationale are presented in Appendix F.

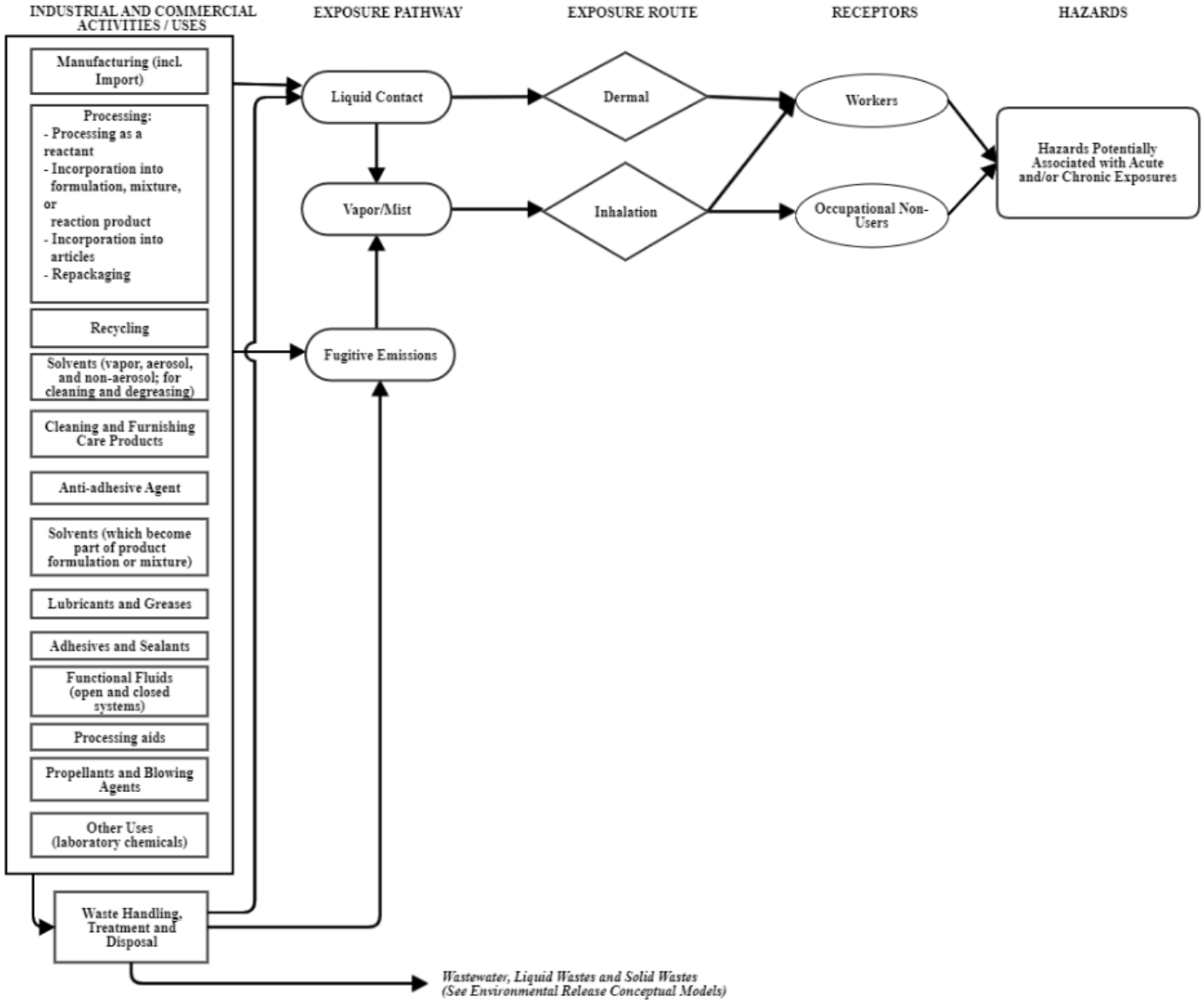

Figure 2-13. *trans*-1,2-Dichloroethylene Occupational Exposure Conceptual Model for Industrial and Commercial Activities and Uses: Worker and Occupational Non-User Exposures and Hazards

The conceptual model presents the exposure pathways, exposure routes and hazards to human receptors from industrial and commercial activities and uses of *trans*-1,2-dichloroethylene.

2.6.2 Conceptual Model for Consumer Activities and Uses

The conceptual model in Figure 2-14 presents the exposure pathways, exposure routes and hazards to human receptors from consumer activities and uses of *trans*-1,2-dichloroethylene. EPA expects inhalation to be the primary route of exposure and plans to analyze inhalation exposures to *trans*-1,2-dichloroethylene vapor for consumers and bystanders. Aerosol application of solvents for cleaning and degreasing and adhesives and sealants may result in an inhalation of mist for consumers and bystanders. Off-gassing of *trans*-1,2-dichloroethylene from polyurethane foam insulation may also result in inhalation exposures to consumers and bystanders. There is potential for dermal exposures to *trans*-1,2-dichloroethylene via direct contact with liquid during consumer uses. Bystanders are not expected to have direct dermal contact to *trans*-1,2-dichloroethylene. EPA plans to analyze direct dermal contact with liquid *trans*-1,2-dichloroethylene for consumers, solvents for cleaning and degreasing, and adhesives and sealants. The supporting rationale for consumer pathways that are in scope for *trans*-1,2-dichloroethylene are included in Appendix G.

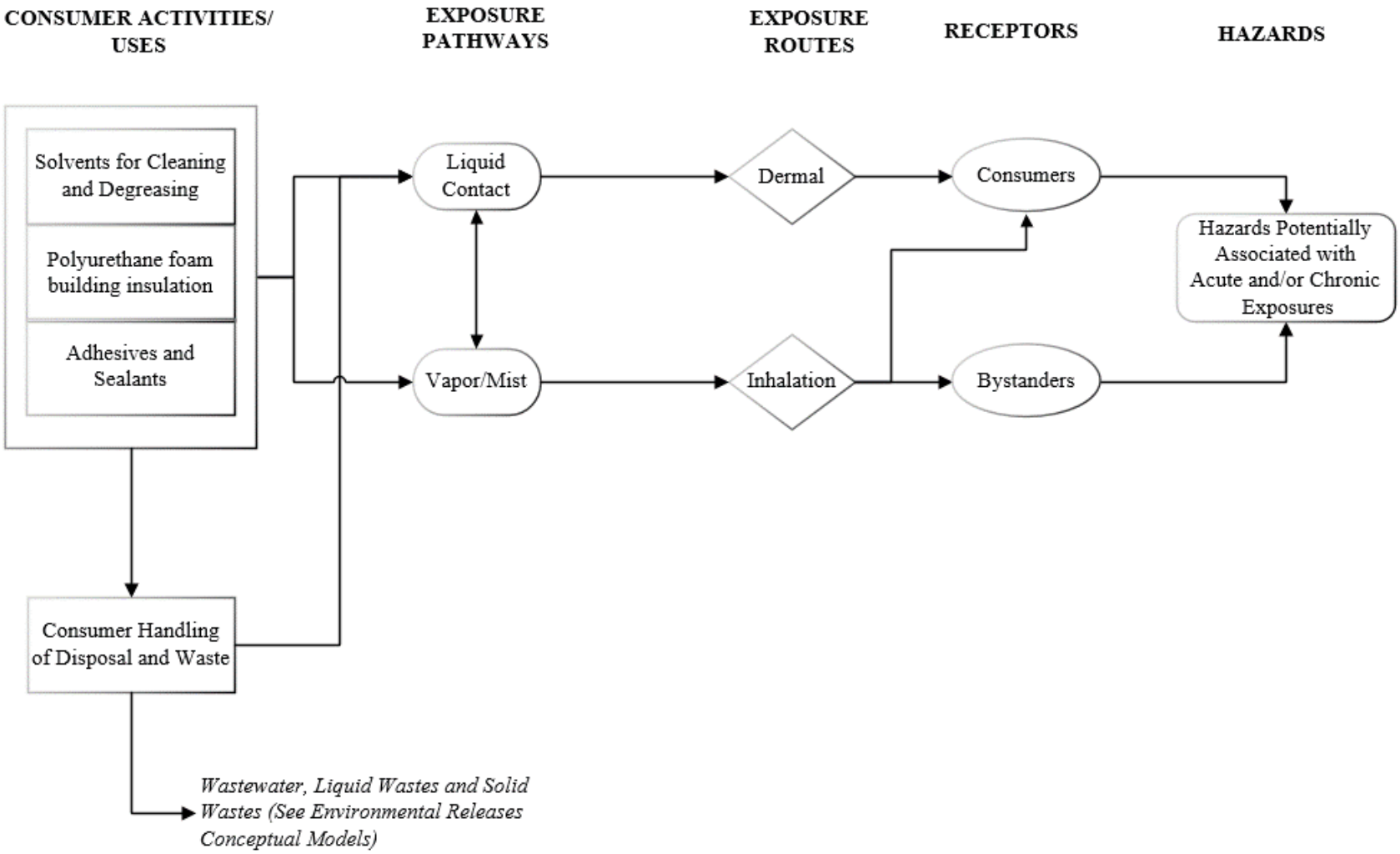

Figure 2-14. *trans*-1,2-Dichloroethylene Conceptual Model for Consumer Activities and Uses: Consumer Exposures and Hazards
The conceptual model presents the exposure pathways, exposure routes and hazards to human receptors from consumer activities and uses of *trans*-1,2-dichloroethylene.

2.6.3 Conceptual Model for Environmental Releases and Wastes: Potential Exposures and Hazards (Regulatory Overlay)

In this section, EPA presents the conceptual models describing the identified exposures (pathways and routes from environmental releases and wastes) and hazards to general population and environmental receptors associated with the conditions of use of *trans*-1,2-dichloroethylene within the scope of the risk evaluation. This section also discusses those pathways that may be addressed pursuant to other EPA-administered laws.

The conceptual model in Figure 2-15 presents the potential exposure pathways, exposure routes and hazards to general population and environmental receptors from releases and waste streams associated with industrial, commercial and consumer uses of *trans*-1,2-dichloroethylene. The conceptual model shows the overlays, labeled and shaded to depict the regulatory programs under EPA-administered statutes and associated pathways that EPA considered for the scope of the risk evaluation. The regulatory programs that cover these environmental release and waste pathways are further described in Section 2.6.3.1.

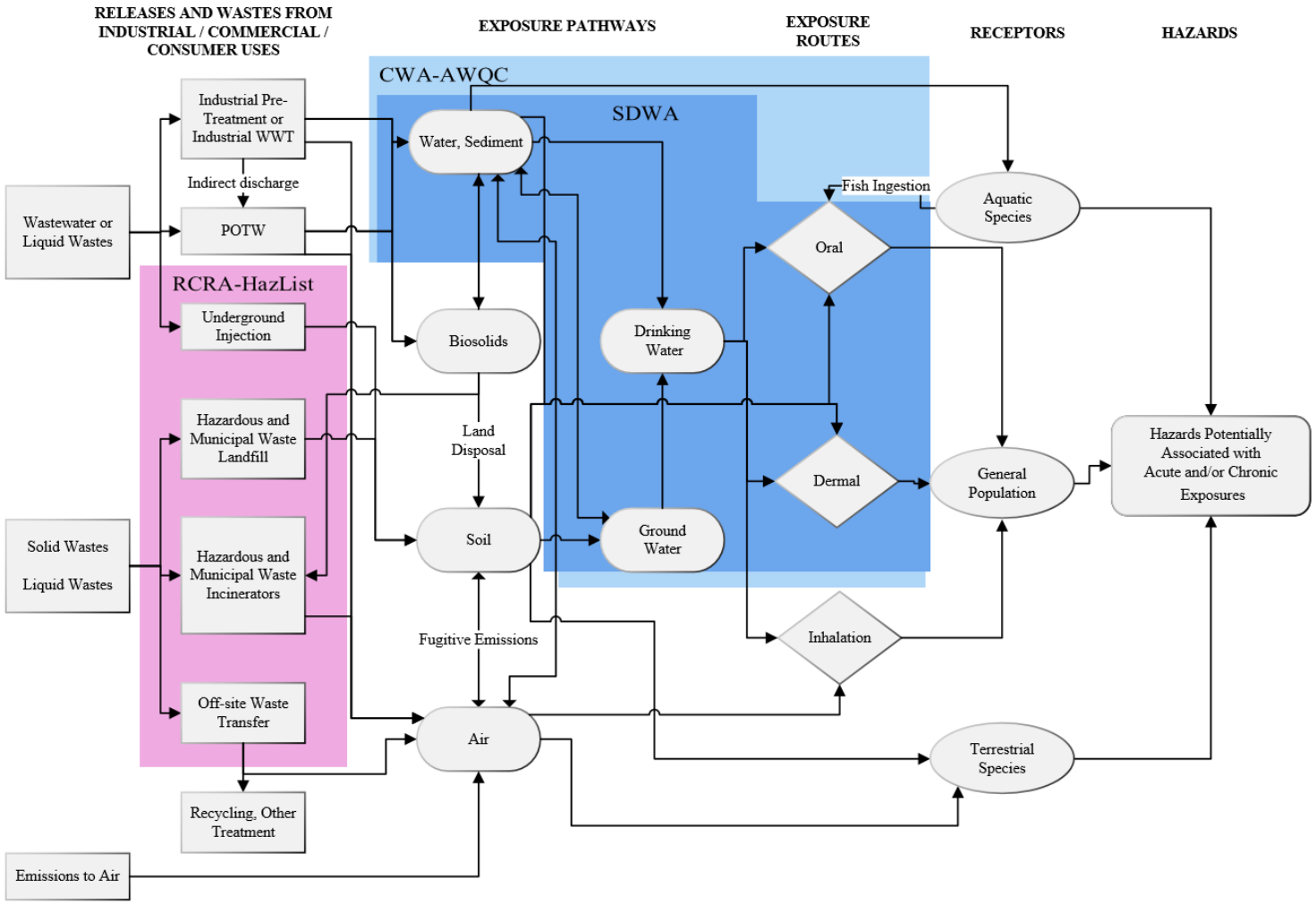

Figure 2-15. *trans*-1,2-Dichloroethylene Conceptual Model for Environmental Releases and Wastes: Environmental and General Population Exposures and Hazards (Regulatory Overlay)

The conceptual model presents the exposure pathways, exposure routes and hazards to human and environmental receptors from releases and wastes from industrial, commercial, and consumer uses of *trans*-1,2-dichloroethylene showing the regulatory laws that adequately assess and manage those pathways.

a) Industrial wastewater or liquid wastes may be treated on-site and then released to surface water (direct discharge), or pre-treated and released to Publicly Owned Treatment Works (POTW) (indirect discharge). For consumer uses, such wastes may be released directly to POTW. Drinking water will undergo further treatment in drinking water treatment plant. Ground water may also be a source of drinking water. Inhalation from drinking water may occur via showering

b) Receptors include PESS (see Section 2.5).

2.6.3.1 Exposure Pathways and Risks Addressed by Other EPA Administered Statutes

In its TSCA Section 6(b) risk evaluations, EPA is coordinating action on certain exposure pathways and risks falling under the jurisdiction of other EPA-administered statutes or regulatory programs. More specifically, EPA is exercising its TSCA authorities to tailor the scope of its risk evaluations, rather than focusing on environmental exposure pathways addressed under other EPA-administered statutes or regulatory programs or risks that could be eliminated or reduced to a sufficient extent by actions taken under other EPA-administered laws. EPA considers this approach to be a reasonable exercise of the Agency's TSCA authorities, which include:

- TSCA Section 6(b)(4)(D): "The Administrator shall, not later than 6 months after the initiation of a risk evaluation, publish the scope of the risk evaluation to be conducted, including the hazards, exposures, conditions of use, and the PESS the Administrator expects to consider…"
- TSCA Section 9(b)(1): "The Administrator shall coordinate actions taken under this chapter with actions taken under other Federal laws administered in whole or in part by the Administrator. If the Administrator determines that a risk to health or the environment associated with a chemical substance or mixture could be eliminated or reduced to a sufficient extent by actions taken under the authorities contained in such other Federal laws, the Administrator shall use such authorities to protect against such risk unless the Administrator determines, in the Administrator's discretion, that it is in the public interest to protect against such risk by actions taken under this chapter."
- TSCA Section 9(e): "…[I]f the Administrator obtains information related to exposures or releases of a chemical substance or mixture that may be prevented or reduced under another Federal law, including a law not administered by the Administrator, the Administrator shall make such information available to the relevant Federal agency or office of the Environmental Protection Agency."
- TSCA Section 2(c): "It is the intent of Congress that the Administrator shall carry out this chapter in a reasonable and prudent manner, and that the Administrator shall consider the environmental, economic, and social impact of any action the Administrator takes or proposes as provided under this chapter."
- TSCA section 18(d)(1): "Nothing in this chapter, nor any amendment made by the Frank R. Lautenberg Chemical Safety for the 21st Century Act, nor any rule, standard of performance, risk evaluation, or scientific assessment implemented pursuant to this chapter, shall affect the right of a State or a political subdivision of a State to adopt or enforce any rule, standard of performance, risk evaluation, scientific assessment, or any other protection for public health or the environment that— (i) is adopted or authorized under the authority of any other Federal law or adopted to satisfy or obtain authorization or approval under any other Federal law…"

These TSCA authorities supporting tailored risk evaluations and intra-agency referrals are described in more detail below:

TSCA Section 6(b)(4)(D)

TSCA Section 6(b)(4)(D) requires EPA, in developing the scope of a risk evaluation, to identify the hazards, exposures, conditions of use, and PESS the Agency "expects to consider" in a risk evaluation. This language suggests that EPA is not required to consider all conditions of use, hazards, or exposure

pathways in risk evaluations. As EPA explained in the "Procedures for Chemical Risk Evaluation Under the Amended Toxic Substances Control Act" ("Risk Evaluation Rule"), "EPA may, on a case-by-case basis, tailor the scope of the risk evaluation… in order to focus its analytical efforts on those exposures that are likely to present the greatest concern, and consequently merit an unreasonable risk determination." 82 FR 33726, 33729 (July 20, 2017).

In the problem formulation documents for many of the first 10 chemicals undergoing risk evaluation, EPA applied the same authority and rationale to certain exposure pathways, explaining that "EPA is planning to exercise its discretion under TSCA 6(b)(4)(D) to focus its analytical efforts on exposures that are likely to present the greatest concern and consequently merit a risk evaluation under TSCA, by excluding, on a case-by-case basis, certain exposure pathways that fall under the jurisdiction of other EPA-administered statutes." This is informed by the legislative history of the amended TSCA, which supports the Agency's exercise of discretion to focus the risk evaluation on areas that raise the greatest potential for risk. See June 7, 2016 Cong. Rec., S3519-S3520. Consistent with the approach articulated in the problem formulation documents, and as described in more detail below, EPA is exercising its authority under TSCA to tailor the scope of exposures evaluated in TSCA risk evaluations, rather than focusing on environmental exposure pathways addressed under other EPA-administered, media-specific statutes and regulatory programs.

TSCA Section 9(b)(1)

In addition to TSCA Section 6(b)(4)(D), the Agency also has discretionary authority under the first sentence of TSCA Section 9(b)(1) to "coordinate actions taken under [TSCA] with actions taken under other Federal laws administered in whole or in part by the Administrator." This broad, freestanding authority provides for intra-agency coordination and cooperation on a range of "actions." In EPA's view, the phrase "actions taken under [TSCA]" in the first sentence of Section 9(b)(1) is reasonably read to encompass more than just risk management actions, and to include actions taken during risk evaluation as well. More specifically, the authority to coordinate intra-agency actions exists regardless of whether the Administrator has first made a definitive finding of risk, formally determined that such risk could be eliminated or reduced to a sufficient extent by actions taken under authorities in other EPA-administered Federal laws, and/or made any associated finding as to whether it is in the public interest to protect against such risk by actions taken under TSCA. TSCA Section 9(b)(1) therefore provides EPA authority to coordinate actions with other EPA offices without ever making a risk finding or following an identification of risk. This includes coordination on tailoring the scope of TSCA risk evaluations to focus on areas of greatest concern rather than exposure pathways addressed by other EPA-administered statutes and regulatory programs, which does not involve a risk determination or public interest finding under TSCA Section 9(b)(2).

In a narrower application of the broad authority provided by the first sentence of TSCA Section 9(b)(1), the remaining provisions of Section 9(b)(1) provide EPA authority to identify risks and refer certain of those risks for action by other EPA offices. Under the second sentence of Section 9(b)(1), "[i]f the Administrator determines that a risk to health or the environment associated with a chemical substance or mixture could be eliminated or reduced to a sufficient extent by actions taken under the authorities contained in such other Federal laws, the Administrator shall use such authorities to protect against such risk unless the Administrator determines, in the Administrator's discretion, that it is in the public interest to protect against such risk by actions taken under [TSCA]." Coordination of intra-agency action on risks under TSCA Section 9(b)(1) therefore entails both an identification of risk, and a referral of any risk that could be eliminated or reduced to a sufficient extent under other EPA-administered laws to the

EPA office(s) responsible for implementing those laws (absent a finding that it is in the public interest to protect against the risk by actions taken under TSCA).

Risk may be identified by OPPT or another EPA office, and the form of the identification may vary. For instance, OPPT may find that one or more conditions of use for a chemical substance present(s) a risk to human or ecological receptors through specific exposure routes and/or pathways. This could involve a quantitative or qualitative assessment of risk based on reasonably available information (which might include, *e.g.*, findings or statements by other EPA offices or other federal agencies). Alternatively, risk could be identified by another EPA office. For example, another EPA office administering non-TSCA authorities may have sufficient monitoring or modeling data to indicate that a particular condition of use presents risk to certain human or ecological receptors, based on expected hazards and exposures. This risk finding could be informed by information made available to the relevant office under TSCA Section 9(e), which supports cooperative actions through coordinated information-sharing.

Following an identification of risk, EPA would determine if that risk could be eliminated or reduced to a sufficient extent by actions taken under authorities in other EPA-administered laws. If so, TSCA requires EPA to "use such authorities to protect against such risk," unless EPA determines that it is in the public interest to protect against that risk by actions taken under TSCA. In some instances, EPA may find that a risk could be sufficiently reduced or eliminated by future action taken under non-TSCA authority. This might include, *e.g.*, action taken under the authority of the Safe Drinking Water Act (SDWA) to address risk to the general population from a chemical substance in drinking water, particularly if the Office of Water has taken preliminary steps such as listing the subject chemical substance on the Contaminant Candidate List (CCL). This sort of risk finding and referral could occur during the risk evaluation process, thereby enabling EPA to use more a relevant and appropriate authority administered by another EPA office to protect against hazards or exposures to affected receptors.

Legislative history on TSCA Section 9(b)(1) supports both broad coordination on current intra-agency actions, and narrower coordination when risk is identified and referred to another EPA office for action. A Conference Report from the time of TSCA's passage explained that Section 9 is intended "to assure that overlapping or duplicative regulation is avoided while attempting to provide for the greatest possible measure of protection to health and the environment." S. Rep. No. 94-1302 at 84. See also H. Rep. No. 114-176 at 28 (stating that the 2016 TSCA amendments "reinforce TSCA's original purpose of filling gaps in Federal law," and citing new language in Section 9(b)(2) intended "to focus the Administrator's exercise of discretion regarding which statute to apply and to encourage decisions that avoid confusion, complication, and duplication"). Exercising TSCA Section 9(b)(1) authority to coordinate on tailoring TSCA risk evaluations is consistent with this expression of Congressional intent.

Legislative history also supports a reading of Section 9(b)(1) under which EPA coordinates intra-agency action, including information-sharing under TSCA Section 9(e), and the appropriately positioned EPA office is responsible for the identification of risk and actions to protect against such risks. See, *e.g.*, Senate Report 114-67, 2016 Cong. Rec. S3522 (under TSCA Section 9, "if the Administrator finds that disposal of a chemical substance may pose risks that could be prevented or reduced under the Solid Waste Disposal Act, the Administrator should ensure that the relevant office of the EPA receives that information"); H. Rep. No. 114-176 at 28, 2016 Cong. Rec. S3522 (under Section 9, "if the Administrator determines that a risk to health or the environment associated with disposal of a chemical substance could be eliminated or reduced to a sufficient extent under the Solid Waste Disposal Act, the Administrator should use those authorities to protect against the risk"). Legislative history on Section 9(b)(1) therefore supports coordination with and referral of action to other EPA offices, especially when

statutes and associated regulatory programs administered by those offices could address exposure pathways or risks associated with conditions of use, hazards, and/or exposure pathways that may otherwise be within the scope of TSCA risk evaluations.

TSCA Sections 2(c) and 18(d)

Finally, TSCA Section 2(c) supports coordinated action on exposure pathways and risks addressed by other EPA-administered statutes and regulatory programs. Section 2(c) directs EPA to carry out TSCA in a "reasonable and prudent manner" and to consider "the environmental, economic, and social impact" of its actions under TSCA. Legislative history from around the time of TSCA's passage indicates that Congress intended EPA to consider the context and take into account the impacts of each action under TSCA. S. Rep. No. 94-698 at 14 ("the intent of Congress as stated in this subsection should guide each action the Administrator takes under other sections of the bill").

Section 18(d)(1) specifies that state actions adopted or authorized under any Federal law are not preempted by an order of no unreasonable risk issued pursuant to TSCA Section 6(i)(1) or a rule to address unreasonable risk issued under TSCA Section 6(a). Thus, even if a risk evaluation were to address exposures or risks that are otherwise addressed by other federal laws and, for example, implemented by states, the state laws implementing those federal requirements would not be preempted. In such a case, both the other federal and state laws, as well as any TSCA Section 6(i)(1) order or TSCA Section 6(a) rule, would apply to the same issue area. See also TSCA Section 18(d)(1)(A)(iii). In legislative history on amended TSCA pertaining to Section 18(d), Congress opined that "[t]his approach is appropriate for the considerable body of law regulating chemical releases to the environment, such as air and water quality, where the states have traditionally had a significant regulatory role and often have a uniquely local concern." Sen. Rep. 114-67 at 26.

EPA's careful consideration of whether other EPA-administered authorities are available, and more appropriate, for addressing certain exposures and risks is consistent with Congress' intent to maintain existing federal requirements and the state actions adopted to locally and more specifically implement those federal requirements, and to carry out TSCA in a reasonable and prudent manner. EPA believes it is both reasonable and prudent to tailor TSCA risk evaluations, rather than attempt to evaluate and regulate potential exposures and risks from those media under TSCA. This approach furthers Congressional direction and EPA aims to efficiently use Agency resources, avoid duplicating efforts taken pursuant to other Agency programs, and meet the statutory deadline for completing risk evaluations.

EPA-administered statutes and regulatory programs that address specific exposure pathways and/or risks are listed as follows:

<u>Drinking Water Pathway</u>
EPA has regular analytical processes to identify and evaluate unregulated drinking water contaminants of potential regulatory concern for public water systems under the SDWA. In addition, the SDWA requires EPA to review and revise "as appropriate" existing drinking water regulations every 6 years.

EPA has promulgated National Primary Drinking Water Regulations (NPDWRs) under the SDWA for *trans*-1,2- dichloroethylene. EPA has set an enforceable Maximum Contaminant Level (MCL) as close as feasible to a health based, non-enforceable Maximum Contaminant Level Goal (MCLG). Public water systems are required to monitor for the regulated chemical based on a standardized monitoring

schedule to ensure compliance with the MCL. The MCL and the MCLG for *trans*-1,2-dichloroethylene in water are both 100 ppb.

The drinking water exposure pathway for *trans*-1,2-dichloroethylene is currently addressed in the NPDWR. As such, EPA does not plan to evaluate exposures to the general population from drinking water exposure in the risk evaluation. This regulatory coverage is represented by the dark blue shading in Figure 2-15. EPA's Office of Water and Office of Pollution Prevention and Toxics will continue to work together providing understanding and analysis of the SDWA regulatory analytical processes and to exchange information related to toxicity and occurrence data on chemicals undergoing risk evaluation under TSCA.

Ambient Water Pathway

EPA has developed Clean Water Act (CWA) Section 304(a) recommended human health criteria for 122 chemicals and aquatic life criteria for 47 chemicals. A subset of these chemicals is identified as "priority pollutants" (103 human health and 27 aquatic life), including *trans*-1,2- dichloroethylene. The CWA requires that states adopt numeric criteria for priority pollutants for which EPA has published recommended criteria under Section 304(a), the discharge or presence of which in the affected waters could reasonably be expected to interfere with designated uses adopted the state. For pollutants with recommended human health criteria, EPA regulations require that state criteria contain sufficient parameters and constituents to protect designated uses. Once states adopt criteria as water quality standards, the CWA requires that National Pollutant Discharge Elimination System (NPDES) discharge permits include effluent limits as stringent as necessary to meet standards CWA Section 301(b)(1)(C). This permit issuance process accounts for risk in accordance with the applicable ambient water exposure pathway (human health or aquatic life as applicable) for the designated water use.

EPA develops recommended water quality criteria under Section 304(a) of the CWA for pollutants in surface water that are protective of aquatic life or human health designated uses. EPA has developed recommended water quality criteria for protection of human health for *trans*-1,2- dichloroethylene which are available for possible adoption into state water quality standards and are available for possible use by NPDES permitting authorities in deriving effluent limits to meet state narrative criteria. See, *e.g.*, 40 CFR part 423, Appendix A; 40 CFR 131.11(b)(1); 40 CFR 122.44(d)(1)(vi). As such, EPA does not plan to evaluate exposures to the general population from surface water in the risk evaluation under TSCA. This regulatory coverage is represented by the light blue shading in Figure 2-15. EPA's OW and OPPT will continue to work together to exchange information related to toxicity of chemicals undergoing risk evaluation under TSCA. EPA may update its CWA Section 304(a*)* water quality criteria for *trans*-1,2-dichloroethylene in the future under the CWA.

EPA has not developed CWA Section 304(a) recommended water quality criteria for the protection of aquatic life for *trans*-1,2-dichloroethylene, so there are no national recommended criteria for this use available for adoption into state water quality standards and available for use in NPDES permits. As such, EPA is evaluating exposures to aquatic species from surface water in the risk evaluation under TSCA. The Office of Water may issue CWA Section 304(a) aquatic life criteria for *trans*-1,2-dichloroethylene in the future.

Onsite releases to land pathway

The Comprehensive Environmental Response, Compensation, and Liability Act, otherwise known as CERCLA, provides broad authority under the statute (generally referred to as Superfund) to clean up uncontrolled or abandoned hazardous-waste sites as well as accidents, spills, and other releases of hazardous substances, pollutants and contaminants into the environment. Through CERCLA, EPA was

given authority to seek out those parties potentially responsible for the release of hazardous substances and either have them clean up the release or compensate the Federal government for undertaking the response action.

CERCLA Section 101(14) defines "hazardous substance" by referencing other environmental statutes, including toxic pollutants listed under CWA Section 307(a); hazardous substances designated pursuant to CWA Section 311(b)(2)(A); hazardous air pollutants listed under CAA Section 112; imminently hazardous substances with respect to which EPA has taken action pursuant to TSCA Section 7; and hazardous wastes having characteristics identified under or listed pursuant to RCRA Section 3001. See 40 CFR 302.4. CERCLA Section 102(a) also authorizes EPA to promulgate regulations designating as hazardous substances those substances which, when released into the environment, may present substantial danger to the public health or welfare or the environment. EPA must also promulgate regulations establishing the quantity of any hazardous substance the release of which must be reported under Section 103. Section 103 requires persons in charge of vessels or facilities to report to the National Response Center if they have knowledge of a release of a hazardous substance above the reportable quantity threshold.

trans-1,2-Dichloroethylene is a hazardous substance under CERCLA. Releases of trans-1,2-dichloroethylene in excess of 1000 lbs within a 24-hour period must be reported (40 CFR 302.4, 302.6). The scope of this EPA TSCA risk evaluation does not include on-site releases to the environment of trans-1,2-dichloroethylene at Superfund sites and subsequent exposure of the general population or non-human species.

Disposal and Soil Pathways

trans-1,2-Dichloroethylene is included on the list of hazardous wastes pursuant to the Resource Conservation and Recovery Act (RCRA) Section 3001 (40 CFR §§ 261.33) as a listed waste on the U (U079) and F (F024, F025) list. The general standard in RCRA Section 3004(a) for the technical criteria that govern the management (treatment, storage, and disposal) of hazardous waste are those "necessary to protect human health and the environment," RCRA 3004(a). The regulatory criteria for identifying "characteristic" hazardous wastes and for "listing" a waste as hazardous also relate solely to the potential risks to human health or the environment (40 CFR §§ 261.11, 261.21-261.24). RCRA statutory criteria for identifying hazardous wastes require EPA to "tak[e] into account toxicity, persistence, and degradability in nature, potential for accumulation in tissue, and other related factors such as flammability, corrosiveness, and other hazardous characteristics." Subtitle C controls cover not only hazardous wastes that are landfilled, but also hazardous wastes that are incinerated (subject to joint control under RCRA Subtitle C and the Clean Air Act (CAA) hazardous waste combustion Maximum Achievable Control Technology (MACT)) or injected into Underground Injection Control (UIC) Class I hazardous waste wells (subject to joint control under Subtitle C and the SDWA)[9].

Emissions to ambient air from municipal and industrial waste incineration and energy recovery units that form combustion by-products from incineration treatment of *trans*-1,2-dichloroethylene wastes may be subject to regulations, as would trans-1,2-dichloroethylene burned for energy recovery.

EPA does not plan to evaluate on-site releases to land that go to underground injection or associated exposures to the general population or terrestrial species in its risk evaluation. TRI reporting in 2018 indicated 4 pounds released to underground injection to Class I wells. Environmental disposal of *trans*-

[9] This is not an exclusive list of Subtitle C authority, as it also covers, for example, disposal to surface impoundments, waste piles, and land treatment.

1,2-dichloroethylene injected into Class I hazardous waste well types fall under the jurisdiction of RCRA and SDWA and disposal of *trans*-1,2-dichloroethylene via underground injection is not likely to result in environmental and general population exposures. See 40 CFR part 144.

EPA has identified releases to land that go to RCRA Subtitle C hazardous waste landfills. Based on 2018 reporting, TRI land disposal includes Subtitle C landfills (3 pounds) with an additional amount transferred to "all other land disposal" both on-site and off-site (24 pounds reported in 2018). Design standards for Subtitle C landfills require double liner, double leachate collection and removal systems, leak detection system, run on, runoff, and wind dispersal controls, and a construction quality assurance program. They are also subject to closure and post-closure care requirements including installing and maintaining a final cover, continuing operation of the leachate collection and removal system until leachate is no longer detected, maintaining and monitoring the leak detection and groundwater monitoring system. Bulk liquids may not be disposed in Subtitle C landfills. Subtitle C landfill operators are required to implement an analysis and testing program to ensure adequate knowledge of waste being managed, and to train personnel on routine and emergency operations at the facility. Hazardous waste being disposed in Subtitle C landfills must also meet RCRA waste treatment standards before disposal. See 40 CFR part 264. As a result, EPA does not plan to evaluate on-site releases to land from RCRA Subtitle C hazardous waste landfills or exposures of the general population or terrestrial species from such releases in the TSCA evaluation. This regulatory coverage is represented by the pink shading in Figure 2-15.

trans-1,2-Dichloroethylene is present in commercial and consumer products that may be disposed of in landfills, such as Municipal Solid Waste (MSW) landfills. On-site releases RCRA Subtitle D municipal solid waste landfills leading to exposures of the general population (including susceptible populations) or terrestrial species from such releases are expected to be minimal based on current TRI releases (*i.e.*, 24 lb in 2018) for *trans*-1,2-dichloroethylene. While permitted and managed by the individual states, municipal solid waste (MSW) landfills are required by federal regulations to implement some of the same requirements as Subtitle C landfills. MSW landfills generally must have a liner system with leachate collection and conduct groundwater monitoring and corrective action when releases are detected. MSW landfills are also subject to closure and post-closure care requirements and must have financial assurance for funding of any needed corrective actions. MSW landfills have also been designed to allow for the small amounts of hazardous waste generated by households and very small quantity waste generators (less than 220 lb per month). Bulk liquids, such as free solvent, may not be disposed of at MSW landfills. See 40 CFR part 258. As a result, EPA does not plan to evaluate on-site releases to land from RCRA Subtitle D municipal solid waste (MSW) landfills or exposures of the general population or terrestrial species from such releases in the TSCA evaluation. This regulatory coverage is represented by the pink shading in Figure 2-15.

On-site releases to land from industrial non-hazardous and construction/demolition waste landfills may occur for *trans*-1,2-dichloroethylene. Industrial non-hazardous and construction/demolition waste landfills are primarily regulated under authorized state regulatory programs. States must also implement limited federal regulatory requirements for siting, groundwater monitoring, and corrective action, and a prohibition on open dumping and disposal of bulk liquids. States may also establish additional requirements such as for liners, post-closure and financial assurance, but are not required to do so. See *e.g.*, RCRA Section 3004(c), 4007; 40 CFR part 257. As a result, EPA does not plan to evaluate on-site releases to land from industrial non-hazardous waste and construction/demolition waste landfills or associated exposures to the general population. This regulatory coverage is represented by the pink shading in Figure 2-15.

2.6.3.2 Conceptual Model for Environmental Releases and Wastes: Potential Exposures and Hazards

As described in Section 2.6.3.1, some pathways in the conceptual models are covered under the jurisdiction of other environmental statutes administered by EPA. The conceptual model depicted in Figure 2-16 presents the exposure pathways, exposure routes and hazards to general population and environmental receptors from releases and wastes from industrial, commercial, and consumer uses of *trans*-1,2-dichloroethylene that EPA plans to evaluate.

The diagram shown in Figure 2-16 includes releases from industrial, commercial and/or consumer uses to water/sediment; biosolids and soil, via direct and indirect discharges to water, that may lead to exposure to aquatic and terrestrial receptors, and to the general population and terrestrial species from emissions to air. The supporting basis for environmental pathways considered for *trans*-1,2-dichloroethylene are included in Appendix H.

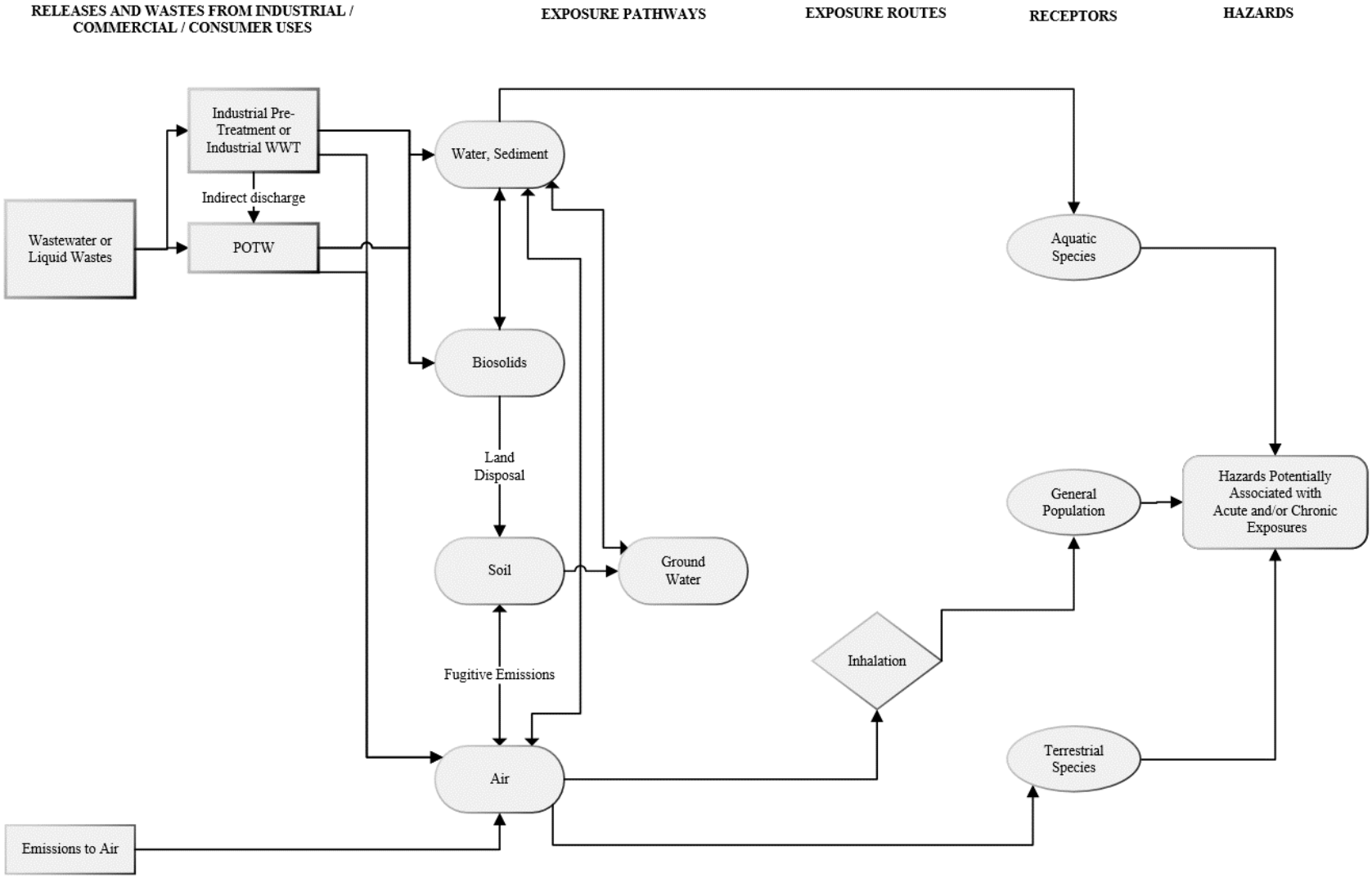

Figure 2-16. *trans*-1,2-Dichloroethylene Conceptual Model for Environmental Releases and Wastes: Environmental and General Population Exposures and Hazards

The conceptual model presents the exposure pathways, exposure routes and hazards to human and environmental receptors from releases and wastes from industrial, commercial, and consumer uses of *trans*-1,2-dichloroethylene that EPA plans to consider in the risk evaluation.

a) Industrial wastewater or liquid wastes may be treated on-site and then released to surface water (direct discharge), or pre-treated and released to POTW (indirect discharge). For consumer uses, such wastes may be released directly to POTW.
b) Receptors include PESS (see Section 2.5).

2.7 Analysis Plan

The analysis plan is based on EPA's knowledge of *trans*-1,2-dichloroethylene resulting from the full-text screening of reasonably available information as described in Section 2.1. EPA encourages submission of additional existing data, such as full study reports or workplace monitoring from industry sources, that may be relevant to EPA's evaluation of conditions of use, exposures, hazards and PESS during risk evaluation. As discussed in the *Application of Systematic Review in TSCA Risk Evaluations* document (U.S. EPA, 2018), targeted supplemental searches during the analysis phase may be necessary to identify additional information (*e.g.*, commercial mixtures) for the risk evaluation of *trans*-1,2-dichloroethylene. For any additional data needs identified during the risk evaluation, EPA may use the Agency's TSCA authorities under Sections 4, 8 or 11, as appropriate.

2.7.1 Physical and Chemical Properties and Environmental Fate

EPA plans to analyze the physical and chemical properties and environmental fate and transport of *trans*-1,2-dichloroethylene as follows:

1) **Review reasonably available measured or estimated physical and chemical properties and environmental fate endpoint data collected using systematic review procedures and, where reasonably available, environmental assessments conducted by other regulatory agencies.**
   EPA plans to evaluate data and information collected through the systematic review methods and public comments about the physical and chemical properties (Appendix B) and fate endpoints (Appendix C), some of which appeared in the *Proposed Designation of trans-1,2-Dichloroethylene (CASRN 156-60-5) as a High-Priority Substance for Risk Evaluation* (U.S. EPA, 2019d). All sources cited in EPA's analysis will be evaluated according to the procedures and metrics described in the *Application of Systematic Review in TSCA Risk Evaluations* (U.S. EPA, 2018). Where the systematic review process does not identify experimentally measured chemical property values of sufficiently high quality, testing will be requested under the TSCA Section 4 authority, or values will be estimated using chemical parameter estimation models as appropriate. Model-estimated fate properties will be reviewed for applicability and quality.

2) **Using measured data and/or modeling, determine the influence of physical and chemical properties and environmental fate endpoints (*e.g.*, persistence, bioaccumulation, partitioning, transport) on exposure pathways and routes of exposure to human and environmental receptors.**
   Measured data and, where necessary, model predictions of physical and chemical properties and environmental fate endpoints will be used to characterize the persistence and movement of *trans*-1,2-dichloroethylene within and across environmental media. The fate endpoints of interest include volatilization, sorption to organic matter in sediments, water solubility, aqueous and atmospheric photolysis rates, aerobic and anaerobic biodegradation rates, and potential bioconcentration and bioaccumulation. These endpoints will be used in exposure calculations.

3) **Conduct a weight of the scientific evidence evaluation of physical and chemical properties and environmental fate data, including qualitative and quantitative sources of information.** During risk evaluation, EPA plans to evaluate and integrate the physical and chemical properties and environmental fate evidence identified in the literature inventory using the methods described in the *Application of Systematic Review in TSCA Risk Evaluations* (U.S. EPA, 2018).

2.7.2 Exposure

EPA plans to analyze exposure levels for indoor air, ambient air, surface water, sediment, aquatic biota, and terrestrial biota associated with exposure to *trans*-1,2-dichloroethylene. Based on its physical and chemical properties, expected sources, and transport and transformation within the outdoor and indoor environment, *trans*-1,2-dichloroethylene is more likely to be present in some media and less likely to be present in others. EPA has not yet determined the exposure levels in these media. Exposure level(s) can be characterized through a combination of reasonably available monitoring data and estimated exposure levels from modeling approaches. Exposure scenarios are combinations of sources (uses), exposure pathways, and exposed receptors. Draft exposure scenarios corresponding to various conditions of use for *trans*-1,2-dichloroethylene are presented in Appendix F, Appendix G, and Appendix H. EPA plans to analyze scenario-specific exposures.

2.7.2.1 Environmental Releases

EPA plans to analyze releases to environmental media as follows:

1) **Review reasonably available published literature and other reasonably available information on processes and activities associated with the conditions of use to analyze the types of releases and wastes generated.**
EPA has reviewed some sources containing information on processes and activities resulting in releases, and the information found is described in Appendix E. EPA plans to continue to review data sources as identified during risk evaluation using the evaluation strategy in the systematic review documentation. Potential sources of environmental release data are summarized in Table 2-6 below:

Table 2-6. Categories and Sources of Environmental Release Data

U.S. EPA TRI Data
U.S. EPA Generic Scenarios
OECD Emission Scenario Documents
Discharge Monitoring Report (DMR) surface water discharge data for *trans*-1,2-dichloroethylene from NPDES-permitted facilities

2) **Review reasonably available chemical-specific release data, including measured or estimated release data (*e.g.*, data from risk assessments by other environmental agencies).**
EPA has reviewed key release data sources including the TRI, and the data from this source is summarized in Section 2.3.3. EPA will continue to consider additional reasonably available information and will evaluate it during development of the risk evaluation. EPA plans to match identified data to applicable conditions of use and identify data gaps where no data are found for particular conditions of use. EPA plans to attempt to address data gaps identified as described in #3 and #4 below by considering potential surrogate data and models.

Additionally, for conditions of use where no measured data on releases are reasonably available, EPA may use a variety of methods including release estimation approaches and assumptions in

the Chemical Screening Tool for Exposures and Environmental Releases (ChemSTEER) (U.S. EPA, 2013).

3) **Review reasonably available measured or estimated release data for surrogate chemicals that have similar uses and physical properties.**
EPA plans to review literature sources identified and if surrogate data are found, these data will be matched to applicable conditions of use for potentially filling data gaps.

4) **Review reasonably available data that may be used in developing, adapting or applying exposure models to the particular risk evaluation.**
This item will be performed after completion of #2 and #3 above. EPA plans to evaluate relevant data to determine whether the data can be used to develop, adapt or apply models for specific conditions of use (and corresponding release scenarios). EPA has identified information from various EPA statutes and sources (including, for example, regulatory limits, reporting thresholds or disposal requirements) that may be relevant to consider for release estimation and environmental exposures. EPA plans to further consider relevant regulatory requirements in estimating releases during risk evaluation.

5) **Review and determine applicability of OECD Emission Scenario Documents (ESDs) and EPA Generic Scenarios to estimation of environmental releases.**
EPA has identified potentially relevant OECD Emission Scenario Documents (ESDs) and EPA Generic Scenarios (GS) that correspond to some conditions of use; for example, the April 2015 ESD on Use of Adhesives (OECD, 2015) and the September 2011 ESD on the Chemical Industry (OECD, 2011) may be useful. EPA intends to critically review these generic scenarios and ESDs to determine their applicability to the conditions of use assessed.

EPA Generic Scenarios are available at the following: https://www.epa.gov/tsca-screening-tools/chemsteer-chemical-screening-tool-exposures-and-environmental-releases.

OECD Emission Scenario Documents are available at the following: http://www.oecd.org/chemicalsafety/risk-assessment/emissionscenariodocuments.htm

If ESDs and GSs are not available, other methods may be considered. EPA may also perform supplemental targeted searches of peer-reviewed or gray literature for applicable models and associated parameters that EPA may use to estimate releases for certain conditions of use. Additionally, for conditions of use where no measured data on releases are available, EPA may use a variety of methods including the application of default assumptions such as standard loss fractions associated with drum cleaning (3%) or single process vessel cleanout (1%).

6) **Map or group each condition of use to a release assessment scenario(s).**
EPA has completed an initial mapping of release scenarios to relevant conditions of use as shown in Appendix F. EPA plans to refine the mapping/grouping of release scenarios based on factors (*e.g.*, process equipment and handling, magnitude of production volume used, and exposure/release sources) corresponding to conditions of use using reasonably available information. EPA may perform supplemental targeted searches of peer-reviewed or gray literature to better understand certain conditions of use to further develop release scenarios.

7) **Evaluate the weight of the scientific evidence of environmental release data.**
During risk evaluation, EPA plans to evaluate and integrate the environmental release evidence identified in the literature inventory using the methods described in the *Application of Systematic Review in TSCA Risk Evaluations* (U.S. EPA, 2018). EPA plans to integrate the data using systematic review methods to assemble the relevant data, evaluate the data for quality and relevance, including strengths and limitations, followed by synthesis and integration of the evidence.

2.7.2.2 Environmental Exposures

EPA plans to analyze the following in developing its environmental exposure assessment of *trans*-1,2-dichloroethylene:

1) **Review available environmental and biological monitoring data for all media relevant to environmental exposure.**
For *trans*-1,2-dichloroethylene, environmental media which will be analyzed include aquatic and terrestrial species, sediment, air and surface water.

2) **Review reasonably available information on releases to determine how modeled estimates of concentrations near industrial point sources compare with available monitoring data.**
EPA plans to analyze and consider reasonably available environmental exposure models that meet the scientific standards under TSCA Section 26(h) and that estimate surface water, and sediment concentrations will be analyzed and considered alongside available surface water, and sediment monitoring data to characterize environmental exposures. Modeling approaches to estimate surface water concentrations, sediment concentrations may generally include the following inputs: direct release into surface water, or sediment, and indirect release into surface water, sediment, fate and transport (partitioning within media) and characteristics of the environment (*e.g.*, river flow, volume of lake, meteorological data).

3) **Determine applicability of existing additional contextualizing information for any monitored data or modeled estimates during risk evaluation.**
Monitoring data or modeled estimates will be reviewed to determine how use patterns have changed over recent years and will determine how representative environmental concentrations are of ongoing use patterns.

   Any studies which relate levels of *trans*-1,2-dichloroethylene in the environment or biota with specific sources or groups of sources will be evaluated.

4) **Group each condition(s) of use to environmental assessment scenario(s).**
Refine and finalize exposure scenarios for environmental receptors by considering combinations of sources (use descriptors), exposure pathways including routes, and populations exposed. For *trans*-1,2-dichloroethylene, the following are noteworthy considerations in constructing exposure scenarios for environmental receptors:

   - Estimates of ambient air, surface water concentrations, and sediment concentrations near industrial point sources based on reasonably available monitoring data.
   - Generally, consider the following modeling inputs: release into the media of interest, fate and transport and characteristics of the environment.
   - Reasonably available biomonitoring data. Monitoring data could be used to compare with species or taxa-specific toxicological benchmarks.

- Applicability of existing additional contextualizing information for any monitored data or modeled estimates during risk evaluation. Review and characterize the spatial and temporal variability, to the extent that data are reasonably available, and characterize exposed aquatic and terrestrial populations.
- Weight of the scientific evidence of environmental occurrence data and modeled estimates

5) **Evaluate the weight of the scientific evidence of environmental occurrence data and modeled estimates.**
During risk evaluation, EPA plans to evaluate and integrate the exposure evidence identified in the literature inventory using the methods described in the *Application of Systematic Review in TSCA Risk Evaluation* (U.S. EPA, 2018).

2.7.2.3 Occupational Exposures

EPA plans to analyze both worker and occupational non-user exposures as follows:

1) **Review reasonably available exposure monitoring data for specific condition(s) of use.**
EPA plans to review reasonably available exposure data including workplace monitoring data found in published literature. These workplace monitoring data include personal exposure monitoring data (direct exposures) and area monitoring data (indirect exposures).

   EPA has not identified available monitoring data from the OSHA and the NIOSH for *trans*-1,2-dichloroethylene. However, EPA has identified some data sources that may contain relevant monitoring data for the various conditions of use. EPA plans to review these sources and extract relevant data for consideration and analysis during risk evaluation.

   EPA plans to consider the influence of applicable regulatory limits and recommended exposure guidelines on occupational exposures in the occupational exposure assessment. The following are some data sources identified thus far:

Table 2-7. Potential Sources of Occupational Exposure Data

1996 ATSDR Toxicological Profile for *trans*-1,2-dichloroethylene

2) **Review reasonably available exposure data for surrogate chemicals that have uses, volatility and physical and chemical properties similar to *trans*-1,2-dichloroethylene.**
EPA plans to review literature sources identified and if surrogate data are found, these data will be matched to applicable conditions of use for potentially filling data gaps.

3) **For conditions of use where data are limited or not reasonably available, review existing exposure models that may be applicable in estimating exposure levels.**
EPA has identified potentially relevant OECD emission scenario documents (ESDs) and EPA generic scenarios (GSs) corresponding to some conditions of use. For example, the April 2015 ESD on Use of Adhesives (OECD, 2015) may be used to estimate occupational exposures. EPA plans to critically review these generic scenarios and ESDs to determine their applicability to the conditions of use assessed. EPA was not able to identify ESDs or GSs corresponding to several conditions of use, including the use of *trans*-1,2-dichloroethylene as a laboratory chemical. EPA plans to perform supplemental targeted searches of peer-reviewed or gray literature to understand those conditions of use, which may inform identification of exposure scenarios. EPA may also

need to perform targeted supplemental searches to identify applicable models that EPA may use to estimate exposures for certain conditions of use.

4) **Review reasonably available data that may be used in developing, adapting or applying exposure models to a particular risk evaluation scenario.**
This will be performed after #2 and #3 are completed. Based on information developed from #2 and #3, EPA plans to evaluate relevant data to determine whether the data can be used to develop, adapt, or apply models for specific conditions of use (and corresponding exposure scenarios). EPA may utilize existing, peer-reviewed exposure models developed by EPA, other government agencies, or reasonably available in the scientific literature, or EPA may elect to develop additional models to assess specific condition(s) of use. Inhalation exposure models may be simple box models or two-zone (near-field/far-field) models. In two-zone models, the near-field exposure represents potential inhalation exposures to workers, and the far-field exposure represents potential inhalation exposures to ONUs.

5) **Consider and incorporate applicable EC and/or PPE into exposure scenarios.**
EPA plans to review potentially relevant data sources on EC and PPE to determine their applicability and incorporation into exposure scenarios during risk evaluation. OSHA recommends employers utilize the hierarchy of controls to address hazardous exposures in the workplace. The hierarchy of controls strategy outlines, in descending order of priority, the use of elimination, substitution, engineering controls, administrative controls, and lastly personal protective equipment (PPE). EPA plans to assess worker exposure pre- and post-implementation of EC, using reasonably available information on control technologies and control effectiveness. For example, EPA may assess worker exposure in industrial use scenarios before and after implementation of local exhaust ventilation.

6) **Map or group each condition of use to occupational exposure assessment scenario(s).**
EPA has identified occupational exposure scenarios and mapped them to relevant conditions of use (see Appendix F). As presented in the fourth column in Table_Apx F-1, EPA has completed an initial mapping of exposure scenarios to conditions of use. EPA plans to refine mapping or grouping of occupational exposure scenarios based on factors (*e.g.*, process equipment and handling, magnitude of production volume used, and exposure/release sources) corresponding to conditions of use as additional information is reviewed during risk evaluation. EPA may perform supplemental targeted searches of peer-reviewed or gray literature to better understand certain conditions of use to further develop exposure scenarios.

7) **Evaluate the weight of the scientific evidence of occupational exposure data, which may include qualitative and quantitative sources of information.**
During risk evaluation, EPA plans to evaluate and integrate the exposure evidence identified in the literature inventory using the methods described in the *Application of Systematic Review in TSCA Risk Evaluation* (U.S. EPA, 2018). EPA plans to rely on the weight of the scientific evidence when evaluating and integrating occupational data. EPA plans to integrate the data using systematic review methods to assemble the relevant data, evaluate the data for quality and relevance, including strengths and limitations, followed by synthesis and integration of the evidence.

2.7.2.4 Consumer Exposures

EPA plans to analyze both consumers using a consumer product and bystanders associated with the consumer using the product as follows:

1) **Group each condition of use to consumer exposure assessment scenario(s).**
Refine and finalize exposure scenarios for consumers by considering combinations of sources (ongoing consumer uses), exposure pathways including routes, and exposed populations.

For *trans*-1,2-dichloroethylene, the following are noteworthy considerations in constructing consumer exposure scenarios:
- Conditions of use
- Duration, frequency and magnitude of exposure
- Weight fraction of chemical in products
- Amount of chemical used

2) **Evaluate the potential of indoor exposure pathways based on reasonably available data.**
Based on the physical and chemical-chem properties of *trans*-1,2-dichloroethylene and the consumer uses identified, inhalation of vapors is expected to be an important indoor exposure pathway for consumers. EPA plans to review all reasonably available information in developing the consumer exposure scenarios and evaluating the exposure pathways in indoor environments.

3) **Review existing indoor exposure models that may be applicable in estimating indoor air exposures.**
Indoor exposure models that estimate emissions from use of consumer products are available. These models generally consider physical and chemical properties (e.g., vapor pressure, molecular weight), product specific properties (e.g., weight fraction of the chemical in the product), use patterns (e.g., duration and frequency of use), user environment (e.g., room of use, ventilation rates), and receptor characteristics (e.g., exposure factors, activity patterns). The OPPT's Consumer Exposure Model (CEM) and other similar models can be used to estimate indoor air exposures from consumer products.

4) **Review reasonably available empirical data that may be used in developing, adapting or applying exposure models to a particular risk evaluation scenario. For example, existing models developed for a chemical assessment may be applicable to another chemical assessment if model parameter data are reasonably available.**
To the extent other organizations have already modeled a *trans*-1,2-dichloroethylene consumer exposure scenario that is relevant to the OPPT's assessment, EPA plans to evaluate those modeled estimates. In addition, if other chemicals similar to *trans*-1,2-dichloroethylene have been modeled for similar uses, those modeled estimates will also be evaluated. The underlying parameters and assumptions of the models will also be evaluated.

5) **Review reasonably available consumer product-specific sources to determine how those exposure estimates compare with each other and with indoor monitoring data reporting *trans*-1,2-dichloroethylene in specific media (*e.g.*, indoor air).**
The availability of *trans*-1,2-dichloroethylene concentration for various conditions of use will be evaluated. This data provides the source term for any subsequent indoor modeling.

6) **Review reasonably available population- or subpopulation-specific exposure factors and activity patterns to determine if PESS need to be further refined.**
For *trans*-1,2,-dichloroethylene, EPA plans to evaluate exposure scenarios that involve PESS and plans to consider age-specific behaviors, activity patterns and exposure factors unique to those

subpopulations. For some exposure scenarios related to consumer uses, EPA plans to consider whether exposures for adults may differ from those of children due to different activities (*e.g.*, children may mouth certain products) or exposure factors (*e.g.*, inhalation rates).

7) **Evaluate the weight of the scientific evidence of consumer exposure estimates based on different approaches.**
EPA plans to rely on the weight of the scientific evidence when evaluating and integrating data related to consumer exposure. The weight of the scientific evidence may include qualitative and quantitative sources of information. EPA plans to integrate the data using systematic review methods to assemble the relevant data, evaluate the data for quality and relevance, including strengths and limitations, followed by synthesis and integration of the evidence.

2.7.2.5 General Population

EPA plans to analyze general population exposures as follows:

1) **Refine and finalize exposure scenarios for general population by considering combinations of sources, conditions of use, exposure pathways and routes.**
For *trans*-1,2-dichloroethylene, the following are noteworthy considerations in constructing exposure scenarios for the general population:

- Review reasonably available environmental and biological monitoring data for media to which general population exposures are expected.
- For exposure pathways where data are not reasonably available, review existing exposure modeling approaches that may be applicable in estimating exposure levels.
- Consider and incorporate applicable media-specific regulations into exposure scenarios or modeling.
- Review reasonably available data that may be used in developing, adapting or applying exposure models to the particular risk evaluation. For example, existing models developed for a chemical assessment may be applicable to another chemical assessment if model parameter data are reasonably available and relevant.
- Review reasonably available information on releases to determine how modeled estimates of concentrations near industrial point sources compare with reasonably available monitoring data.
- Review reasonably available population- or subpopulation-specific exposure factors and activity patterns to determine if PESS need be further defined.
- Evaluate the weight of the scientific evidence of general population exposure data.
- Map or group each condition of use to general population exposure assessment scenario(s).

EPA plans to evaluate a variety of data types to determine which types are most appropriate when quantifying exposure scenarios. Environmental monitoring data, biomonitoring data, modeled estimates, experimental data, epidemiological data, and survey-based data can all be used to inform exposure scenarios. EPA anticipates that there will be a range in the potential exposures associated with the exposure scenarios identified in Section 2.6.

After refining and finalizing exposure scenarios, EPA plans to quantify concentrations and/or doses for these scenarios. The number of scenarios will depend on the conditions of use, exposure pathways and receptors. The number of scenarios is also dependent upon the

reasonably available data and approaches to quantify scenarios. When quantifying exposure scenarios, EPA plans to use a tiered approach. First-tier analysis may be qualitative, semi-quantitative, or quantitative. The results of first tier analyses inform whether scenarios require more refined analysis. Refined analyses will be iterative and include careful consideration of variability and uncertainty.

2) **For exposure pathways where empirical data is not reasonably available, review existing exposure models that may be applicable in estimating exposure levels.**
   For *trans*-1,2-dichloroethylene, media where exposure models will be considered for general population exposure include models that estimate ambient air concentrations, surface water concentrations, and sediment concentrations, and uptake from aquatic and terrestrial environments into edible aquatic and terrestrial organisms.

3) **Review reasonably available exposure modeled estimates. For example, existing models developed for a previous *trans*-1,2-dichloroethylene chemical assessment may be applicable to the EPA's assessment. In addition, another chemical's assessment may also be applicable if model parameter data are reasonably available.**
   To the extent other organizations have already modeled *trans*-1,2-dichloroethylene general population exposure scenario that is relevant to the OPPT's assessment, EPA plans to evaluate those modeled estimates. In addition, if modeled estimates for other chemicals with similar physical or chemical properties and similar uses are available, those modeled estimates will also be evaluated. The underlying parameters and assumptions of the models will also be evaluated.

4) **Review reasonably available information on releases to determine how modeled estimates of concentrations near industrial point sources compare with reasonably available monitoring data.**
   The expected releases from industrial facilities are changing over time. Any modeled concentrations based on recent release estimates will be carefully compared with reasonably available monitoring data to determine representativeness.

5) **Review reasonably available information about population- or subpopulation-specific exposure factors and activity patterns to determine if PESS need to be further defined (*e.g.*, early life and/or puberty as a potential critical window of exposure).**
   For *trans*-1,2-dichloroethylene, exposure scenarios that involve PESS will consider age-specific behaviors, activity patterns, and exposure factors unique to those subpopulations. For example, children will have different intake rates for dust, and diet than adults.

6) **Evaluate the weight of the scientific evidence of general population exposure estimates based on different approaches.**
   During risk evaluation, EPA plans to evaluate and integrate the exposure evidence identified in the literature inventory using the methods described in the *Application of Systematic Review in TSCA Risk Evaluations* (U.S. EPA, 2018).

2.7.3 Hazards (Effects)

2.7.3.1 Environmental Hazards

EPA plans to conduct an environmental hazard assessment of *trans*-1,2-dichloroethylene as follows:

1) **Review reasonably available environmental hazard data, including data from alternative test methods (*e.g.*, computational toxicology and bioinformatics; high-throughput screening methods; data on categories and read-across; *in vitro* studies).**
   EPA plans to analyze the hazards of *trans*-1,2-dichloroethylene to aquatic and terrestrial organisms, including plants, invertebrates (*e.g.*, insects, arachnids, mollusks, crustaceans), and vertebrates (*e.g.*, mammals, birds, amphibians, fish, reptiles) across exposure durations and conditions if potential environmental hazards are identified through systematic review results and public comments. Additional types of environmental hazard information will also be considered (*e.g.*, analogue and read-across data) when characterizing the potential hazards of *trans*-1,2-dichloroethylene to aquatic and terrestrial organisms.

   EPA plans to evaluate environmental hazard data using the evaluation strategies laid out in the *Application of Systematic Review in TSCA Risk Evaluation* (U.S. EPA, 2018). The study evaluation results will be documented in the risk evaluation phase and data from acceptable studies will be extracted and integrated in the risk evaluation process.

   Mechanistic data may include analyses of alternative test data such as novel *in vitro* test methods and high throughput screening. The association between acute and chronic exposure scenarios to the agent and each health outcome will also be integrated. Study results will be extracted and presented in evidence tables or another appropriate format by organ/system.

2) **Derive hazard thresholds for aquatic and terrestrial organisms.**
   Depending on the robustness of the evaluated data for a particular organism or taxa (*e.g.*, aquatic invertebrates), environmental hazard values (*e.g.*, EC_x. LC_x, NOEC, LOEC) may be derived and used to further understand the hazard characteristics of *trans*-1,2-dichloroethylene to aquatic and terrestrial species. Identified environmental hazard thresholds may be used to derive concentrations of concern (COC), based on endpoints that may affect populations of organisms or taxa analyzed.

3) **Evaluate the weight of the scientific evidence of environmental hazard data.**
   During risk evaluation, EPA plans to evaluate and integrate the environmental hazard evidence identified in the literature inventory using the methods described in the *Application of Systematic Review in TSCA Risk Evaluation* (U.S. EPA, 2018).

4) **Consider the route(s) of exposure, based on reasonably available monitoring and modeling data and other available approaches to integrate exposure and hazard assessments.**
   EPA plans to consider aquatic (*e.g.*, water and sediment exposures) and terrestrial pathways in the *trans*-1,2-dichloroethylene conceptual model. These organisms may be exposed to *trans*-1,2-dichloroethylene via a number of environmental pathways (*e.g.*, surface water, sediment, soil, diet).

5) **Consider a persistent, bioaccumulative, and toxic (PBT) assessment of *trans*-1,2-dichloroethylene.**

EPA plans to consider the persistence, bioaccumulation, and toxic (PBT) potential of *trans*-1,2-dichloroethylene after reviewing relevant physical and chemical properties and exposure pathways. EPA plans to assess the reasonably available studies identified from the systematic review process relating to bioaccumulation and bioconcentration (*e.g.*, BAF, BCF) of *trans*-1,2-dichloroethylene. In addition, EPA plans to integrate traditional environmental hazard endpoint values (*e.g.*, LC_{50}, LOEC) and exposure concentrations (*e.g.*, surface water concentrations, tissue concentrations) for *trans*-1,2-dichloroethylene with the fate parameters (*e.g.*, BAF, BCF, BMF, TMF).

6) **Conduct an environmental risk estimation and characterization of *trans*-1,2-dichloroethylene.**
   EPA plans to conduct a risk estimation and characterization of *trans*-1,2-dichloroethylene to identify if there are risks to the aquatic and terrestrial environments from the measured and/or predicted concentrations of *trans*-1,2-dichloroethylene in environmental media (*e.g.*, water, sediment). Risk quotients (RQs) may be derived by the application of hazard and exposure benchmarks to characterize environmental risk (U.S. EPA, 1998; Barnthouse et al., 1982). Analysis of risk for characterization includes a confidence statement in risk estimation which qualitative judgment describing the certainty of the risk estimate considering the strength the evidence scores for hazard and exposure and the limitations, and relevance.

2.7.3.2 Human Health Hazards

EPA plans to analyze human health hazards as follows:

1) **Review reasonably available human health hazard data, including data from alternative test methods (*e.g.*, computational toxicology and bioinformatics; high-throughput screening methods; data on categories and read-across; *in vitro* studies; systems biology).**
   EPA plans to evaluate human health studies using the evaluation strategies laid out in the *Application of Systematic Review in TSCA Risk Evaluation* (U.S. EPA, 2018) and updates to the epidemiological data quality criteria released with the first ten risk evaluations. The study evaluation results will be documented in the risk evaluation phase and data from acceptable studies will be extracted and integrated in the risk evaluation process.

   Mechanistic data may include analyses of alternative test data such as novel *in vitro* test methods and high throughput screening. The association between acute and chronic exposure scenarios to the agent and each health outcome will also be integrated. Study results will be extracted and presented in evidence tables or another appropriate format by organ/system.

2) **In evaluating reasonably available data, determine whether particular human receptor groups may have greater susceptibility to the chemical's hazard(s) than the general population.**
   Reasonably available human health hazard data will be evaluated to ascertain whether some human receptor groups may have greater susceptibility than the general population to *trans*-1,2-dichloroethylene hazard(s). Susceptibility of particular human receptor groups to *trans*-1,2-dichloroethylene will be determined by evaluating information on factors that influence susceptibility.

   EPA has reviewed some sources containing hazard information associated with susceptible populations and lifestages such as pregnant women and infants. Pregnancy (*i.e.*, gestation) and

childhood are potential susceptible lifestages for *trans*-1,2-dichloroethylene exposure. EPA may quantify these differences in the risk evaluation following further evaluation of the reasonably available data and information.

3) **Conduct hazard identification (the qualitative process of identifying non-cancer and cancer endpoints) and dose-response assessment (the quantitative relationship between hazard and exposure) for identified human health hazard endpoints.**
Human health hazards from acute and chronic exposures will be identified by evaluating the human and animal data that meet the systematic review data quality criteria described in the *Application of Systematic Review in TSCA Risk Evaluation* (U.S. EPA, 2018). Hazards identified by studies meeting data quality criteria will be grouped by routes of exposure relevant to humans (*e.g.*, oral, dermal, inhalation) and by the cancer and noncancer endpoints identified in Section 2.4.2.

   Dose-response assessment will be performed in accordance with EPA guidance (U.S. EPA, 2012a, 2011a, 1994) developing points of departure (POD) for either margins of exposure (MOEs), cancer slope factors (CSFs), oral slope factors (OSFs), and/or inhalation unit risks (IURs). Dose-response analyses may be used if the data meet data quality criteria and if additional information on the identified hazard endpoints are not reasonably available or would not alter the analysis.

   The cancer mode of action (MOA) analyses determine the relevancy of animal data to human risk and how data can be quantitatively evaluated. If cancer hazard is determined to be applicable to *trans*-1,2-dichloroethylene, EPA plans to evaluate information on genotoxicity and the MOA for all cancer endpoints to determine the appropriate approach for quantitative cancer assessment in accordance with the *U.S. EPA Guidelines for Carcinogen Risk Assessment* (U.S. EPA, 2005a). In accordance with EPA's *Supplemental Guidance for Assessing Susceptibility from Early-life Exposures to Carcinogens* (U.S. EPA, 2005b), EPA plans to determine whether age-dependent adjustment factors (ADAFs) are appropriate for *trans*-1,2-dichloroethylene for specific conditions of use based upon potential exposures to children.

4) **Derive points of departure (PODs) where appropriate; conduct benchmark dose modeling depending on the reasonably available data. Adjust the PODs as appropriate to conform (*e.g.*, adjust for duration of exposure) to the specific exposure scenarios evaluated.**
Hazard data will be evaluated to determine the type of dose-response modeling that is applicable. Where modeling is feasible, a set of dose-response models that are consistent with a variety of potentially underlying biological processes will be applied to empirically model the dose-response relationships in the range of the observed data consistent with the EPA's *Benchmark Dose Technical Guidance Document* (U.S. EPA, 2012a). Where dose-response modeling is not feasible, NOAELs or LOAELs will be identified. Non-quantitative data will also be evaluated for contribution to weight of the scientific evidence or for evaluation of qualitative endpoints that are not appropriate for dose-response assessment.

   EPA plans to evaluate whether the reasonably available PBPK and empirical kinetic models are adequate for route-to-route and interspecies extrapolation of the POD, or for extrapolation of the POD to standard exposure durations (*e.g.*, lifetime continuous exposure). If application of the PBPK model is not possible, oral PODs may be adjusted by $BW^{3/4}$ scaling in accordance with U.S. EPA (2011b), and inhalation PODs may be adjusted by exposure duration and chemical

properties in accordance with U.S. EPA (1994). EPA plans to evaluate whether the available PBPK and empirical kinetic models are adequate for route-to-route and interspecies extrapolation of the POD, or for extrapolation of the POD to standard exposure durations (*e.g.*, lifetime continuous exposure). If application of the PBPK model is not possible, oral PODs may be adjusted by $BW^{3/4}$ scaling in accordance with U.S. EPA (2011b), and inhalation PODs may be adjusted by exposure duration and chemical properties in accordance with U.S. EPA (1994).

5) **Evaluate the weight of the scientific evidence of human health hazard data.**
During risk evaluation, EPA plans to evaluate and integrate the human health hazard evidence identified in the literature inventory under acute and chronic exposure conditions using the methods described in the *Application of Systematic Review in TSCA Risk Evaluations* (U.S. EPA, 2018).

6) **Consider the route(s) of exposure (*e.g.*, oral, inhalation, dermal), reasonably available route-to-route extrapolation approaches; biomonitoring data; and approaches to correlate internal and external exposures to integrate exposure and hazard assessment.**
At this stage of review, EPA believes there will be sufficient reasonably available data to conduct a dose-response analysis and/or benchmark dose modeling for the oral route of exposure. EPA plans to also evaluate any potential human health hazards following dermal and inhalation exposure to *trans*-1,2-dichloroethylene, which could be important for worker, consumer and general population risk analysis. Reasonably available data will be assessed to determine whether or not a point of departure can be identified for the dermal and inhalation routes.

   If sufficient reasonably available toxicity studies are not identified through the systematic review process to assess risks from inhalation or dermal exposure, then a route-to-route extrapolation may be needed. The preferred approach is to use a PBPK model (U.S. EPA, 2006a). Without an adequate PBPK model, considerations regarding the adequacy of data for route-to-route extrapolation are described in *Methods for Derivation of Inhalation Reference Concentrations and Application of Inhalation Dosimetry* (U.S. EPA, 1994). EPA may use these considerations when determining whether to extrapolate from the oral to the inhalation route of exposure. Similar approaches for oral-to-dermal route extrapolation are described in EPA guidance document *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)* (U.S. EPA, 2004a).

   If there are acceptable inhalation data after completion of systematic review, EPA may also consider extrapolating from the inhalation to the dermal route if first-pass metabolism through the liver via the oral route is expected because in that case, use of data from the oral route is not recommended (U.S. EPA, 1994). EPA may also consider inhalation-to-dermal route extrapolation if an inhalation toxicity study with a sensitive hazard endpoint is used to evaluate risks. Based on these considerations, EPA extrapolated from the inhalation to the dermal route for several of the first ten risk evaluations under amended TSCA, including methylene chloride (U.S. EPA, 2020e) and carbon tetrachloride (U.S. EPA, 2020c).

7) **Conduct a human health risk estimation and characterization of *trans*-1,2-dichloroethylene.**
Analysis of risk for characterization includes a confidence statement in risk estimation. This confidence statement is based on qualitative judgment describing the certainty of the risk

estimate considering the strength of the evidence scores for hazard and exposure along with their limitations and relevance. The lowest confidence evaluation for either hazard or exposure will drive the overall confidence estimate.

2.7.4 Summary of Risk Approaches for Characterization

Risk characterization is an integral component of the risk assessment process for both environmental and human health risks. EPA plans to derive the risk characterization in accordance with the EPA's *Risk Characterization Handbook* (U.S. EPA, 2000). As defined in the EPA's Risk Characterization Policy, "the risk characterization integrates information from the preceding components of the risk evaluation and synthesizes an overall conclusion about risk that is complete, informative and useful for decision makers." Risk characterization is considered to be a conscious and deliberate process to bring all important considerations about risk, not only the likelihood of the risk but also the strengths and limitations of the assessment, and a description of how others have assessed the risk into an integrated picture.

The level of information contained in each risk characterization varies according to the type of assessment for which the characterization is written. Regardless of the level of complexity or information, the risk characterization for TSCA risk evaluations will be prepared in a manner that is transparent, clear, consistent, and reasonable (TCCR) (U.S. EPA, 2000). As discussed in 40 CFR 702.43, risk characterization has a number of considerations. This is the step where EPA integrates the hazard and exposure assessments into risk estimates for the identified populations (including any PESS) and ecological characteristics and weighs the scientific evidence for the identified hazards and exposures. The risk characterization does not consider costs or other nonrisk factors, and takes into account, "where relevant, the likely duration, intensity, frequency, and number of exposures under the condition(s) of use…." The risk characterization also summarizes the following considerations: (1) uncertainty and variability in each step of the risk evaluation; (2) data quality, and any applicable assumptions used; (3) alternative interpretations of data and analyses, where appropriate; and (4) any considerations for environmental risk evaluations, if necessary (*e.g.,* related to nature and magnitude of effects).

EPA plans to also be guided by EPA's Information Quality Guidelines (U.S. EPA, 2002) as it provides guidance for presenting risk information. Consistent with those guidelines, in the risk characterization, EPA plans to also identify: (1) Each population addressed by an estimate of applicable risk effects; (2) the expected risk or central estimate of risk for the PESS affected; (3) each appropriate upper-bound or lower bound estimate of risk; (4) each significant uncertainty identified in the process of the assessment of risk effects and the studies that would assist in resolving the uncertainty; and (5) peer reviewed studies known to the Agency that support, are directly relevant to, or fail to support any estimate of risk effects and the methodology used to reconcile inconsistencies in the scientific information.

2.8 Peer Review

Peer review will be conducted in accordance with EPA's regulatory procedures for chemical risk evaluations, including using EPA's Peer Review Handbook (U.S. EPA, 2015) and other methods consistent with Section 26 of TSCA (see 40 CFR 702.45). As explained in the Risk Evaluation Rule, the purpose of peer review is for the independent review of the science underlying the risk assessment. Peer review will therefore address aspects of the underlying science as outlined in the charge to the peer review panel such as hazard assessment, assessment of dose-response, exposure assessment, and risk characterization. The draft risk evaluation for *trans*-1,2-dichloroethylene will be peer reviewed.

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APPENDICES

Appendix A ABBREVIATED METHODS FOR SEARCHING AND SCREENING

A.1 Literature Search of Publicly Available Databases

A.1.1 Search Term Genesis and Chemical Verification

To develop the chemical terms for the subsequent literature search for *trans*-1,2-dichloroethylene, several online sources were queried.

- California Department of Pesticide Regulation: https://www.cdpr.ca.gov/docs/chemical/monster2.htm
- USEPA Chemistry Dashboard: https://comptox.epa.gov/dashboard
- University of Hertfordshire PPDB: Pesticide Properties DataBase: https://sitem.herts.ac.uk/aeru/ppdb/en/search.htm
- USEPA Reregistration Eligibility Decision (RED) documents: https://archive.epa.gov/pesticides/reregistration/web/html/status.html
- Office of Pesticide Programs Pesticide Chemical Search: https://ofmpub.epa.gov/apex/pesticides/f?p=CHEMICALSEARCH:1
- Food and Agriculture Organization of the United Nations: http://www.fao.org/home/en/
- PAN Pesticides Database: http://www.pesticideinfo.org/Search_Chemicals.jsp

Prior to inclusion in the search term string, all forms of chemical names were subjected to verification from several potential sources (*e.g.*, US EPA Chemistry Dashboard, STN International-CAS; see complete list of sources for chemical verification in Table_Apx A-1). From these sources, all chemical names, synonyms, CAS number(s), trade names, etc. were documented and used to generate terms for database searches.

Table_Apx A-1. Sources of Verification for Chemical Names and Structures

CHEMICAL SOURCE	CONTENTS	DOCUMENT LOCATION
Chemistry Dashboard (https://comptox.epa.gov/dashboard)	CAS Numbers, Synonyms, Structures, Properties, Environmental Fate and Transport.	Online
Dictionary of Chemical Names and Synonyms	Wide assortment of chemical compounds by chemical name and synonym, has CAS index and some structure data	ECOTOX
Farm Chemicals Handbook-1992	Pesticide information, CAS numbers and synonyms, some structure data ***Sometimes CAS number presented for a compound is for the main constituent only	ECOTOX
OPPT SMILES Verification Source	Structure Data	Electronic verification
RTECS (Registry of Toxic Effects of chemical substance, 1983-84 ed., 2 vols)	Chemical names, synonyms and CAS numbers	ECOTOX

CHEMICAL SOURCE	CONTENTS	DOCUMENT LOCATION
Sigma – Aldrich website58784 http://www.sigma-aldrich.com	Organic and inorganic Compounds by chemical name, has CAS index and some structure and Physical Property data	Online
STN International (CAS) 1994	***Most complete source of chemical name, synonym and structure information, no physical properties	Online
The Pesticide Manual 10th edition, 1994	Pesticide Compounds by chemical name, synonym, product code, has CAS index and some structure and Physical Property data	ECOTOX
TSCA (Toxic Substances Control Act Chemical Substance Inventory, 1985 ed., 5 vols)	Chemical names, synonyms and CAS numbers	ECOTOX
World Wide Web (misc. web sources) A copy of the verification page is saved to the Attachments tab of the chemical entry. This includes company MSDS sheets or Chemical Labels.	Chemical names, synonyms and CAS numbers	Online
California Department of Pesticide Regulation (http://www.cdpr.ca.gov/dprdatabase.htm)	Multiple databases containing chemicals, pesticides, companies, products, etc.	Online
PAN Pesticide Database (http://www.pesticideinfo.org/Search_Chemicals.jsp)	Pesticides searchable by name or CAS #. Includes CAS #, Name, synonyms, targets, toxicity data, related chemicals and regulatory information.	Online
US EPA Office of Pesticide Programs Pesticide Fate Database – No web access available. An electronic copy of the data file is located at the Contractor site: PFATE_37_Tables.mdb.	Multiple databases containing chemicals, pesticides, companies, products, etc.	Online

A.1.2 Publicly Available Database Searches

The databases listed below were searched for literature containing the chemical search terms. Database searching occurred during April and May of 2019 by an information specialist and the results were stored in the Health and Environmental Research Online (HERO) database and assigned a HERO reference identification number[10]. The present literature search focused only on the chemical name (including synonyms and trade names) with no additional limits. Full details of the search strategy for each database are presented in Appendix A.1.2.1.

After initial deduplication in HERO[11], these studies were imported into SWIFT Review software (Howard et al., 2016) to identify those references most likely to be applicable to each discipline area (*i.e.*, consumer, environmental, and general population exposure, occupational exposure and environmental releases, environmental hazards, human health hazards, and fate and physical chemistry).

[10] EPA's HERO database provides access to the scientific literature behind EPA science assessments. The database includes more than 600,000 scientific references and data from the peer-reviewed literature used by EPA to develop its regulations.

[11] Deduplication in HERO involves first determining whether a matching unique ID exists (e.g., PMID, WOSid, or DOI). If one matches one that already exists in HERO, HERO will tag the existing reference instead of adding the reference again. Second, HERO checks if the same journal, volume, issue and page number are already in HERO. Third, HERO matches on the title, year, and first author. Title comparisons ignore punctuation and case.

A.1.2.1 Query Strings for the Publicly Available Database Searches on *trans*-1,2-Dichloroethylene

Table_Apx A-2 presents a list of the data sources, the search dates and number of peer-reviewed references resulting from the searches for *trans*-1,2-dichloroethylene. The sources are found as online databases and the resulting references were gathered and uploaded into the EPA Health and Environmental Research Online (HERO) database for literature screening.

Table_Apx A-2. Summary of Data Sources, Search Dates and Number of Peer-Reviewed Literature Search Results for *trans*-1,2-Dichloroethylene

Source	Date of Search	Number of References
Current Contents	05/09/2019	838
ProQuest CSA	05/09/2019	1913
Dissertation Abstracts	05/09/2019	0
Science Direct	05/09/2019	578
Agricola	05/09/2019	351
TOXNET	05/09/2019	979
PubMed	07/03/2019	597
UNIFY	05/09/2019	35
Totals:		**5291**

GENERAL:
General search terms were compiled and used in the search strategies for each of the databases/sources listed below. Based upon the online search manuals for the respective databases/sources, it was necessary to construct searches as noted for each of the sources. The search terms are listed below in full for each source and noted if the general search terms or other search terms were used.

."(1E)-1,2-Dichloroethene" OR "(1Z)-1,2-Dichloroethene" OR "(E)-1,2-Dichloroethene" OR "(E)-1,2-Dichloroethylene" OR "(Z)-1,2-Dichloroethene" OR "(Z)-1,2-Dichloroethylene" OR "1,2-cis-Dichloroethene" OR "1,2-cis-Dichloroethylene" OR "1,2-DICHLORAETHEN" OR "1,2-Dichlor-aethen" OR "1,2-Dichlorethylen" OR "1,2-Dichloroethene" OR "1,2-Dichloroethylene" OR "1,2-trans-Dichloroethene" OR "1,2-trans-Dichloroethylene" OR "Acetalyne dichloride" OR "Acetylene dichloride" OR "Acetylene dichloride, cis-" OR "BRN 1420761" OR "cis-1,2-Dichlorethylene" OR "cis-1,2-Dichloroethene" OR "cis-1,2-Dichloroethylene" OR "cis-Dichlorethylen" OR "cis-Dichloroethene" OR "cis-Dichloroethylene" OR "Dichloro-1,2-ethylene" OR "EINECS 205-860-2" OR "HCC 1130c" OR "HCC 1130t" OR "NCI-C56031" OR "NSC 60512" OR "NSC 6149" OR "R 1130t" OR "sym-Dichloroethylene" OR "trans-1,2-Dichloroethene" OR "trans-1,2-Dichloroethene radical cation" OR "trans-1,2-Dichloroethylene" OR "trans-Acetylene dichloride" OR "trans-Dichloroethene" OR "trans-dichloroethylene" OR "trans-Dichloroethylene radical cation" OR "UNII-FYO9G15JYD" OR "UNII-XU9RUA6YUT" OR "Vertrel CCA"

CURRENT CONTENTS CONNECT: (access.webofknowledge.com)
General Search Terms applied to the search strategy for Current Contents.
Date Searched:
Date Range of Search: 1970 to Present
N = 838

TS=("(1E)-1,2-Dichloroethene" OR "(1Z)-1,2-Dichloroethene" OR "(E)-1,2-Dichloroethene" OR "(E)-1,2-Dichloroethylene" OR "(Z)-1,2-Dichloroethene" OR "(Z)-1,2-Dichloroethylene" OR "1,2-cis-Dichloroethene" OR "1,2-cis-Dichloroethylene" OR "1,2-DICHLORAETHEN" OR "1,2-Dichloraethen" OR "1,2-Dichlorethylen" OR "1,2-Dichloroethene" OR "1,2-Dichloroethylene" OR "1,2-trans-Dichloroethene" OR "1,2-trans-Dichloroethylene" OR "Acetalyne dichloride" OR "Acetylene dichloride" OR "Acetylene dichloride, cis-" OR "BRN 1420761" OR "cis-1,2-Dichlorethylene" OR "cis-1,2-Dichloroethene" OR "cis-1,2-Dichloroethylene" OR "cis-Dichlorethylen" OR "cis-Dichloroethene" OR "cis-Dichloroethylene" OR "Dichloro-1,2-ethylene" OR "EINECS 205-860-2" OR "HCC 1130c" OR "HCC 1130t" OR "NCI-C56031" OR "NSC 60512" OR "NSC 6149" OR "R 1130t" OR "sym-Dichloroethylene" OR "trans-1,2-Dichloroethene" OR "trans-1,2-Dichloroethene radical cation" OR "trans-1,2-Dichloroethylene" OR "trans-Acetylene dichloride" OR "trans-Dichloroethene" OR "trans-dichloroethylene" OR "trans-Dichloroethylene radical cation" OR "UNII-FYO9G15JYD" OR "UNII-XU9RUA6YUT" OR "Vertrel CCA")

N = 838

PROQUEST Agricultural and Scientific Database: (www.csa.com)
General Search Terms applied to the search strategy for ProQuest Agricultural and Scientific Database.

Date Searched:
Date Range of Search: 1900 to Present
N = 1,913

ALL("(1E)-1,2-Dichloroethene" OR "(1Z)-1,2-Dichloroethene" OR "(E)-1,2-Dichloroethene" OR "(E)-1,2-Dichloroethylene" OR "(Z)-1,2-Dichloroethene" OR "(Z)-1,2-Dichloroethylene" OR "1,2-cis-Dichloroethene" OR "1,2-cis-Dichloroethylene" OR "1,2-DICHLORAETHEN" OR "1,2-Dichloraethen" OR "1,2-Dichlorethylen" OR "1,2-Dichloroethene" OR "1,2-Dichloroethylene" OR "1,2-trans-Dichloroethene" OR "1,2-trans-Dichloroethylene" OR "Acetalyne dichloride" OR "Acetylene dichloride" OR "Acetylene dichloride, cis-" OR "BRN 1420761" OR "cis-1,2-Dichlorethylene" OR "cis-1,2-Dichloroethene" OR "cis-1,2-Dichloroethylene" OR "cis-Dichlorethylen" OR "cis-Dichloroethene" OR "cis-Dichloroethylene" OR "Dichloro-1,2-ethylene" OR "EINECS 205-860-2" OR "HCC 1130c" OR "HCC 1130t" OR "NCI-C56031" OR "NSC 60512" OR "NSC 6149" OR "R 1130t" OR "sym-Dichloroethylene" OR "trans-1,2-Dichloroethene" OR "trans-1,2-Dichloroethene radical cation" OR "trans-1,2-Dichloroethylene" OR "trans-Acetylene dichloride" OR "trans-Dichloroethene" OR "trans-dichloroethylene" OR "trans-Dichloroethylene radical cation" OR "UNII-FYO9G15JYD" OR "UNII-XU9RUA6YUT" OR "Vertrel CCA") AND STYPE("Scholarly Journals" OR Reports OR Thesis OR "Government Documents") AND LA(ENG)
N = 1,913

PROQUEST Dissertations and Theses: (search.proquest.com)
General Search Terms applied to the search strategy for ProQuest Dissertations and Theses.

Date Searched:
Date Range of Search: 1900 to Present
N = 0

ALL("(1E)-1,2-Dichloroethene" OR "(1Z)-1,2-Dichloroethene" OR "(E)-1,2-Dichloroethene" OR "(E)-1,2-Dichloroethylene" OR "(Z)-1,2-Dichloroethene" OR "(Z)-1,2-Dichloroethylene" OR "1,2-cis-Dichloroethene" OR "1,2-cis-Dichloroethylene" OR "1,2-DICHLORAETHEN" OR "1,2-Dichlor-aethen" OR "1,2-Dichlorethylen" OR "1,2-Dichloroethene" OR "1,2-Dichloroethylene" OR "1,2-trans-Dichloroethene" OR "1,2-trans-Dichloroethylene" OR "Acetalyne dichloride" OR "Acetylene dichloride" OR "Acetylene dichloride, cis-" OR "BRN 1420761" OR "cis-1,2-Dichlorethylene" OR "cis-1,2-Dichloroethene" OR "cis-1,2-Dichloroethylene" OR "cis-Dichlorethylen" OR "cis-Dichloroethene" OR "cis-Dichloroethylene" OR "Dichloro-1,2-ethylene" OR "EINECS 205-860-2" OR "HCC 1130c" OR "HCC 1130t" OR "NCI-C56031" OR "NSC 60512" OR "NSC 6149" OR "R 1130t" OR "sym-Dichloroethylene" OR "trans-1,2-Dichloroethene" OR "trans-1,2-Dichloroethene radical cation" OR "trans-1,2-Dichloroethylene" OR "trans-Acetylene dichloride" OR "trans-Dichloroethene" OR "trans-dichloroethylene" OR "trans-Dichloroethylene radical cation" OR "UNII-FYO9G15JYD" OR "UNII-XU9RUA6YUT" OR "Vertrel CCA") AND LA(ENG)
N = 0

SCIENCE DIRECT: (www.sciencedirect.com)
General Search Terms applied to the search strategy for Science Direct

Date Searched:
Date Range of Search: 1823 to Present
N = 578

Science Direct 01:
"(1E)-1,2-Dichloroethene" OR "(1Z)-1,2-Dichloroethene" OR "(E)-1,2-Dichloroethene" OR "(E)-1,2-Dichloroethylene" OR "(Z)-1,2-Dichloroethene" OR "(Z)-1,2-Dichloroethylene" OR "1,2-cis-Dichloroethene" OR "1,2-cis-Dichloroethylene" OR "1,2-DICHLORAETHEN"
N = 23

Science Direct 02:
"1,2-Dichlor-aethen" OR "1,2-Dichlorethylen" OR "1,2-Dichloroethene" OR "1,2-Dichloroethylene" OR "1,2-trans-Dichloroethene" OR "1,2-trans-Dichloroethylene" OR "Acetalyne dichloride" OR "Acetylene dichloride" OR "Acetylene dichloride, cis-"
N = 240

Science Direct 03:
"BRN 1420761" OR "cis-1,2-Dichlorethylene" OR "cis-1,2-Dichloroethene" OR "cis-1,2-Dichloroethylene" OR "cis-Dichlorethylen" OR "cis-Dichloroethene" OR "cis-Dichloroethylene" OR "Dichloro-1,2-ethylene" OR "EINECS 205-860-2"
N = 220

Science Direct 04:
"HCC 1130c" OR "HCC 1130t" OR "NCI-C56031" OR "NSC 60512" OR "NSC 6149" OR "R 1130t" OR "sym-Dichloroethylene" OR "trans-1,2-Dichloroethene" OR "trans-1,2-Dichloroethene radical cation"
N = 21

Science Direct 05:
"trans-1,2-Dichloroethylene" OR "trans-Acetylene dichloride" OR "trans-Dichloroethene" OR "trans-dichloroethylene" OR "trans-Dichloroethylene radical cation" OR "UNII-FYO9G15JYD" OR "UNII-XU9RUA6YUT" OR "Vertrel CCA"
N = 74

AGRICOLA: (www.nal.usda.gov)
General Search Terms applied to the search strategy for Agricola. The Agricola database contains a significant amount of gray literature including proceedings, symposia, and progress reports from government and educational institutions. Agricola is not used when conducting a search for the Office of Water.

Date Searched:
Date Range of Search: 15th century to the Present
N = 351

Agricola 01:
(1E)-1,2-Dichloroethene
(1Z)-1,2-Dichloroethene
(E)-1,2-Dichloroethene
(E)-1,2-Dichloroethylene
(Z)-1,2-Dichloroethene
(Z)-1,2-Dichloroethylene
1,2-cis-Dichloroethene
1,2-cis-Dichloroethylene
1,2-DICHLORAETHEN
1,2-Dichlor-aethen
N = 13

Agricola 02:
1,2-Dichlorethylen
1,2-Dichloroethene
1,2-Dichloroethylene
1,2-trans-Dichloroethene
1,2-trans-Dichloroethylene
Acetalyne dichloride
Acetylene dichloride
Acetylene dichloride, cis-
BRN 1420761
cis-1,2-Dichlorethylene
N = 131

Agricola 03:
cis-1,2-Dichloroethene
cis-1,2-Dichloroethylene

cis-Dichlorethylen
cis-Dichloroethene
cis-Dichloroethylene
Dichloro-1,2-ethylene
EINECS 205-860-2
HCC 1130c
HCC 1130t
NCI-C56031
N = 181

Agricola 04:
NSC 60512
NSC 6149
R 1130t
sym-Dichloroethylene
trans-1,2-Dichloroethene
trans-1,2-Dichloroethene radical cation
trans-1,2-Dichloroethylene
trans-Acetylene dichloride
trans-Dichloroethene
trans-dichloroethylene
N = 26

Agricola 05:
trans-Dichloroethylene radical cation
UNII-FYO9G15JYD
UNII-XU9RUA6YUT
Vertrel CCA
N = 0

TOXNET: (toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?TOXLINE)
General Search Terms applied to the search strategy for TOXNET.

Date Searched:
Date Range of Search: 1900 to Present
N = 979

TOXNET 01:
156-60-5 OR 73245-64-4 OR 156-59-2 OR 540-59-0 OR 43695-79-0
N = 979

TOXNET 02:
1438395-68-6
N = 0

PubMed:

PubMed may be accessed through the EPA Desktop Library (https://www.ncbi.nlm.nih.gov/pubmed/)

Date Searched: 07/03/2019
Date Range of Search: 1900 to present
N = 597

"(1E)-1,2-Dichloroethene" OR "(1Z)-1,2-Dichloroethene" OR "(E)-1,2-Dichloroethene" OR "(E)-1,2-Dichloroethylene" OR "(Z)-1,2-Dichloroethene" OR "(Z)-1,2-Dichloroethylene" OR "1,2-cis-Dichloroethene" OR "1,2-cis-Dichloroethylene" OR "1,2-DICHLORAETHEN" OR "1,2-Dichlor-aethen" OR "1,2-Dichlorethylen" OR "1,2-Dichloroethene" OR "1,2-Dichloroethylene" OR "1,2-trans-Dichloroethene" OR "1,2-trans-Dichloroethylene" OR "Acetalyne dichloride" OR "Acetylene dichloride" OR "Acetylene dichloride, cis-" OR "BRN 1420761" OR "cis-1,2-Dichlorethylene" OR "cis-1,2-Dichloroethene" OR "cis-1,2-Dichloroethylene" OR "cis-Dichlorethylen" OR "cis-Dichloroethene" OR "cis-Dichloroethylene" OR "Dichloro-1,2-ethylene" OR "EINECS 205-860-2" OR "HCC 1130c" OR "HCC 1130t" OR "NCI-C56031" OR "NSC 60512" OR "NSC 6149" OR "R 1130t" OR "sym-Dichloroethylene" OR "trans-1,2-Dichloroethene" OR "trans-1,2-Dichloroethene radical cation" OR "trans-1,2-Dichloroethylene" OR "trans-Acetylene dichloride" OR "trans-Dichloroethene" OR "trans-dichloroethylene" OR "trans-Dichloroethylene radical cation" OR "UNII-FYO9G15JYD" OR "UNII-XU9RUA6YUT" OR "Vertrel CCA"
N = 597

ECOTOX UNIFY:
This is an internal EPA database that is not accessible to the public. Results from the ECOTOX Unify search strategy.

Date Searched:
Date Range of Search: all years
N = 35

A.1.2.2 Data Prioritization for Environmental Hazard, Human Health Hazard, Fate and Physical Chemistry

In brief, SWIFT Review has pre-set literature search strategies ("filters") developed by information specialists that can be applied to identify studies that are more likely to be useful for identifying human health and ecotoxicity content from those that likely do not (*e.g.*, analytical methods). The filters function like a typical search strategy where studies are tagged as belonging to a certain filter if the terms in the filter literature search strategy appear in title, abstract, keyword or medical subject headings (MeSH*)* fields content. The applied SWIFT Review filters focused on lines of evidence: human, animal models for human health, ecological taxa (which includes ecotoxicological animal models, plants, and other taxa), and *in vitro* studies. The details of the search strategies that underlie the filters are available online. Studies not retrieved using these filters were not considered further. Studies that included one or more of the search terms in the title, abstract, keyword, or MeSH fields were exported as a RIS file for screening in Swift-ActiveScreener or DistillerSR[12].

[12] DistillerSR is a web-based systematic review software used to screen studies available at https://www.evidencepartners.com/products/distillersr-systematic-review-software.

A.1.2.3 Data prioritization for Occupational Exposures and Environmental Releases and General Population, Consumer and Environmental Exposures

To prioritize references related to occupational exposure, environmental release, general population exposure, consumer exposure, and environmental exposure, EPA used positive and negative seed studies to build a classification model in SWIFT Review. The positive seeds were identified using relevant literature pool for the first ten TSCA risk evaluations, while the negative seeds were identified from a subset of literature for the current high-priority substances. The model was then applied to the unclassified literature to generate a classification score for each reference. Scores above a certain threshold value were then prioritized for further review in SWIFT-ActiveScreener.

A.2 Peer-Reviewed Screening Process

The studies identified from publicly available database searches and SWIFT-Review filtering/prioritization were housed in HERO system and imported into SWIFT-ActiveScreener or DistillerSR for title/abstract and full-text screening. Both title/abstract and full-text screening were conducted by two independent reviewers. Screening is initiated with a pilot phase of screening (between 10 and 50) studies to identify areas where clarification in screening criteria might be needed or chemical-specific supplemental material tags might be identified. Records that met PECO (or equivalent criteria (Appendix A.2.1) during title and abstract screening were considered for full-text screening. At both the title/abstract and full-text review levels, screening conflicts were resolved by topic-specific experts and/or discussion among the primary screeners. For citations with no abstract, the articles are initially screened based on all or some of the following: title relevance (titles that suggest a record is not relevant can be excluded rather than marked as unclear), and page numbers (articles two pages in length or less were assumed to be conference reports, editorials, or letters). During title/abstract or full-text level screening in DistillerSR, studies that did not meet the PECO criteria, but which could provide supporting information were categorized (or "tagged") as supplemental information.

It is important to emphasize that being tagged as supplemental material does not mean the study would necessarily be excluded from consideration in an assessment. The initial screening level distinctions between a study meeting the PECO criteria and a supplemental study are often made for practical reasons and the tagging structure (as seen in the literature inventory trees and heat maps in Section 2.1 of this document) are designed to ensure the supplemental studies are categorized for easy retrieval if needed while conducting the assessment. The impact on the assessment conclusions of individual studies tagged as supporting material is often difficult to assess during the screening phase of the assessment. These studies may emerge as being critically important to the assessment and need to be evaluated and summarized at the individual study level (*e.g.*, cancer MOA mechanistic or non-English-language studies), or be helpful to provide context (*e.g.*, summarize current levels of exposure, provide hazard evidence from routes or durations of exposure not pertinent to the PECO), or not be cited at all in the assessment (*e.g.*, individual studies that contribute to a well-established scientific conclusion). Studies maybe be tagged as supplemental material during either title and abstract or full-text screening. When tagged as supplemental material during title and abstract screening, it may not be completely clear whether the chemical of interest is reported in the study (*i.e.*, abstracts may not describe all chemicals investigated). In these cases, studies are still tagged with the expectation that if full-text retrieval is pursued, then additional screening would be needed to clarify if the study is pertinent.

A.2.1 Inclusion/Exclusion Criteria

A PECO statement is typically used to focus the research question(s), search terms, and inclusion/exclusion criteria in a systematic review. PECO criteria were developed *a priori* to screening and modified to fit the various discipline areas supporting the TSCA risk evaluations. Variations include the RESO (receptor, exposure, scenario/setting, and outcome) used for the occupational exposure and environmental releases discipline, and PESO (pathways/processes, exposures, setting/scenario, and outcomes) used by the fate and transport discipline. All PECOs and PECO-equivalent criteria can be found in the following sections.

A.2.1.1 PECO for Environmental and Human Health Hazards

The PECO used in this evidence map to identify literature pertinent to *trans*-1,2-dichloroethylene effects on human health and environmental hazard is presented in Table_Apx A-3. In addition to the PECO criteria, studies containing potentially relevant supplemental material were tracked and categorized during the literature screening process as outlined in Table_Apx A-4.

Table_Apx A-3. Hazards Title and Abstract and Full-text PECO Criteria for *trans*-1,2-Dichloroethylene

PECO Element	Evidence
P	• **Human:** Any population and life stage (*e.g.*, occupational or general population, including children and other sensitive populations). • **Animal:** Aquatic and terrestrial species (live, whole organism) from any life stage (*e.g.*, preconception, in utero, lactation, peripubertal, and adult stages). Tests of the single toxicants in *in vitro* systems or on live, whole, taxonomically verifiable organisms (*e.g.*, gametes, embryos, or plant or fungal sections capable of forming whole, new organisms) that are not bacteria, humans, monkeys, viruses, or yeast. In most cases, transgenic animal models will get screened as "yes" or "unclear" at the Title and Abstract (TIAB) screening level. Although certain non-mammalian model systems are increasing used to identify potential human health hazards (*e.g.*, *Xenopus* and zebrafish), for simplicity animal models will be further inventoried according to the categorization below: – Human health models: rat, mouse, rabbit, dog, hamster, guinea pig, cat, non-human primate, pig, hen (neurotoxicity only) – Environmental models: invertebrates (*e.g.*, insects, spiders, crustaceans, mollusks, and worms) and vertebrates (*e.g.*, mammals and all amphibians, birds, fish, and reptiles). All hen studies (including neurotoxicity studies) will be included for ecotoxicological models. • **Plants:** All aquatic and terrestrial species (live), including algal, moss, lichen and fungi species. **Screener note:** • To identify human health and environmental hazards, other organisms not listed above in their respective categories can also be used. Non-mammalian model systems are increasingly used to identify potential human health hazards (*e.g.*, Xenopus, zebrafish), and traditional human health models (*e.g.*, rodents) can be used to identify potential environmental hazard. Neurotoxicity studies performed in hens (*e.g.*, OECD 418 and 419) are considered relevant to both human and eco hazard. • PECO considerations should be directed toward effects on target species only and not on the indirect effects expressed in taxa as a result of chemical treatment (*e.g.*, substance is lethal to a targeted pest species leading to positive effects on plant growth due to diminished presence of the targeted pest species).
E	**Relevant forms and isomers** • *trans*-1,2- Dichloroethylene (CASRN 156-60-5) o Related isomers:

PECO Element	Evidence
	○ 1,2-Dichloroethylene (CASRN 540-59-0) ○ cis-1,2-Dichloroethylene (CASRN 156-59-2) For synonyms see the EPA Chemistry Dashboard. • **Human:** Any exposure to *trans*-1,2- dichloroethylene. • **Animal:** Any exposure to *trans*-1,2- dichloroethylene, including via water, soil or sediment, injection (*i.e.*, oral or topical), gavage, diet, dermal, and inhalation. • **Plants:** Exposure to 1*trans*-1,2- dichloroethylene via water and/or soil, with reported concentration and duration. Studies involving exposures to mixtures will be included only if they also include exposure to one of these solvents alone. Screener note: Field studies with media concentrations (surface water, interstitial water, soil) and/or body/tissue concentrations of animals or plants are to be identified as ***Supplemental*** if any biological effects are reported.
C	• **Human:** A comparison or referent population exposed to lower levels (or no exposure/exposure below detection limits) of *trans*-1,2- dichloroethylene, or exposure to one of these solvents for shorter periods of time. case-crossover, case-referent, case-only, case-specular, case-cohort, case-parent, nested case-control study designs are all included. • **Animal and Plants:** A concurrent control group exposed to vehicle-only treatment and/or untreated control (control could be a baseline measurement). **Screener note:** • If no control group is explicitly stated or implied (*e.g.*, by mention of statistical results that could only be obtained if a control group was present), the study will be marked as **unclear** during Title/Abstract Screening. • All case reports and case studies/series describing findings in a sample size of less than 20 people in any setting (*e.g.*, occupation, general population) will be tracked as "potentially relevant supplemental information".
O	• **Human**: All health outcomes (cancer and noncancer). • **Animal and Plants**: All biological effects (including bioaccumulation from laboratory studies with concurrently measured water and tissue concentrations). **Screener note:** • **Measurable biological effects relevant for humans, animals and plants may include but are not limited to** mortality, behavioral, population, cellular, physiological, growth, reproduction of an acceptable organism to a chemical toxicant.

Table_Apx A-4. Major Categories of "Potentially Relevant" Supplemental Materials for *trans*-1,2-Dichloroethylene

Category	Evidence
Mechanistic studies	Studies reporting measurements related to a health outcome that inform the biological or chemical events associated with phenotypic effects, in both mammalian and non-mammalian model systems, including *in vitro*, *in vivo* (by various non-inhalation routes of exposure), *ex vivo*, and *in silico* studies.

Category	Evidence
ADME, PBPK, and toxicokinetic	Studies designed to capture information regarding absorption, distribution, metabolism, and excretion (ADME), toxicokinetic studies, or physiologically based pharmacokinetic (PBPK) models.
Susceptible populations (no health outcome)	Studies that identify potentially susceptible subgroups; for example, studies that focus on a specific demographic, life stage, or genotype.
Mixture studies	Mixture studies that are not considered PECO-relevant because they do not contain an exposure or treatment group assessing only the chemical of interest.
Case reports or case series	Case reports ($n \leq 3$ cases) and case series/studies (<20 cases) will be tracked as potentially relevant supplemental information.
Records with no original data	Records that do not contain original data, such as other agency assessments, informative scientific literature reviews, editorials or commentaries.
Conference abstracts	Records that do not contain sufficient documentation to support study evaluation and data extraction.
Field Studies	Field studies where there are accompanying body/tissue concentrations of animals without any biological effects reported

A.2.1.2 PECO for Consumer, Environmental, and General Population Exposures.

Table_Apx A-5. Generic Inclusion Criteria for the Data Sources Reporting Exposure Data on General Population, Consumers and Environmental Receptors

PECO Element	Evidence
Population	**Human:** General population; consumers; bystanders in the home; near-facility populations (includes industrial and commercial facilities manufacturing, processing, or using the chemical substance); children; susceptible populations (life stages, preexisting conditions, genetic factors), pregnant women; lactating women, women of childbearing age. Many human population groups may be exposed. No chemical-specific exclusions are suggested at this time.
	Environmental: aquatic species, terrestrial species, terrestrial plants, aquatic plants (field studies only)
Exposure	**Expected Primary Exposure Sources, Pathways, Routes:** Pathways: indoor air/vapor/mist; indoor dust; particles; outdoor/ambient air; surface water; biosolids; sediment; breastmilk; food items containing *trans*-1,2-dichloroethylene including fish; consumer product uses in the home (including consumer product containing chemical); Routes of Exposure: Inhalation, Oral, Dermal
Comparator (Scenario)	**Human:** Consider media-specific background exposure scenarios and use/source specific exposure scenarios as well as which receptors are and are not reasonably exposed across the projected exposure scenarios.
	Environmental Consider media-specific background exposure scenarios and use/source specific exposure scenarios as well as which receptors are and are not reasonably exposed across the projected exposure scenarios.

PECO Element	Evidence
Outcomes for Exposure Concentration or Dose	**Human:** Acute, subchronic, and/or indoor air and water concentration estimates (mg/m^3 or mg/L). Both external potential dose and internal dose based on biomonitoring and reverse dosimetry mg/kg/day will be considered. Characteristics of consumer products or articles (weight fraction, emission rates, etc) containing *trans*-1,2-dichloroethylene
	Environmental: A wide range of ecological receptors will be considered (range depending on available ecotoxicity data) using surface water concentrations, sediment concentrations.

Table_Apx A-6. Pathways Identified as Supplemental for *trans*-1,2-Dichloroethylene[a]

Chemical	Drinking Water	Ambient Air	Air Disposal	Land Disposal	Underground Disposal	Ground Water
***trans*-1,2-Dichloroethylene**	X	--	--	X	X	X

[a] "Supplemental pathways" refer to pathways addressed by other EPA administered statutes (see Section 2.6.3.1). Studies tagged under these pathways provide media information that is not prioritized in the screening process.

A.2.1.3 RESO for Occupational Exposure and Environmental Releases

EPA developed a generic RESO statement to guide the screening of engineering and occupational exposure data or information sources for the TSCA risk evaluations. Data or information sources that comply with the inclusion criteria specified in the RESO statement are eligible for inclusion, considered for evaluation, and possibly included in the environmental release and occupational exposure assessments. On the other hand, data or information sources that fail to meet the criteria in the RESO statement are excluded from further consideration.

Assessors seek information on various chemical-specific engineering and occupational exposure data needs as part of the process of developing the exposure assessment for each risk evaluation. EPA uses the RESO statement (Table_Apx A-7) along with the information in Table_Apx A-8 when screening the engineering and occupational exposure data and information.

Table_Apx A-7. Inclusion Criteria for Data Sources Reporting Engineering and Occupational Exposure Data

RESO Element	Evidence
Receptors	• Humans: Workers, including occupational non-users • Environment: All environmental receptors (relevant release estimates input to Exposure) Please refer to the conceptual models for more information about the environmental and human receptors included in the TSCA risk evaluation.

RESO Element	Evidence
Exposure	• Worker exposure to and relevant environmental releases of the chemical substance from occupational scenarios: Dermal and inhalation exposure routes (as indicated in the conceptual model) Oral route (as indicated in the conceptual model) Please refer to the conceptual models for more information about the routes and media/pathways included in the TSCA risk evaluation.
Setting or Scenario	• Any occupational setting or scenario resulting in worker exposure and relevant environmental releases (includes all manufacturing, processing, use, disposal.
Outcomes	• Quantitative estimates* of worker exposures and of relevant environmental releases from occupational settings • General information and data related and relevant to the occupational estimates*

* Metrics (*e.g.*, mg/kg/day or mg/m^3 for worker exposures, kg/site/day for releases) are determined by toxicologists for worker exposures and by exposure assessors for releases; also, the Engineering, Release and Occupational Exposure Data Needs (Table_Apx A-8) provides a list of related and relevant general information.
TSCA=Toxic Substances Control Act

Table_Apx A-8. Engineering, Environmental Release and Occupational Data Necessary to Develop the Environmental Release and Occupational Exposure Assessments

Objective Determined during Scoping	Type of Data [a]
General Engineering Assessment (may apply to Occupational Exposures and / or Environmental Releases)	Description of the life cycle of the chemical(s) of interest, from manufacture to end-of-life (*e.g.*, each manufacturing, processing, or use step), and material flow between the industrial and commercial life cycle stages. The total annual U.S. volume (lb/yr or kg/yr) of the chemical(s) of interest manufactured, imported, processed, and used; and the share of total annual manufacturing and import volume that is processed or used in each life cycle step. Description of processes, equipment, and unit operations during each industrial/ commercial life cycle step. Material flows, use rates, and frequencies (lb/site-day or kg/site-day and days/yr; lb/site-batch and batches/yr) of the chemical(s) of interest during each industrial/ commercial life cycle step. Note: if available, include weight fractions of the chemicals (s) of interest and material flows of all associated primary chemicals (especially water). Number of sites that manufacture, process, or use the chemical(s) of interest for each industrial/ commercial life cycle step and site locations. Concentration of the chemical of interest
Occupational Exposures	Description of worker activities with exposure potential during the manufacture, processing, or use of the chemical(s) of interest in each industrial/commercial life cycle stage. Potential routes of exposure (*e.g.*, inhalation, dermal). Physical form of the chemical(s) of interest for each exposure route (*e.g.*, liquid, vapor, mist) and activity. Breathing zone (personal sample) measurements of occupational exposures to the chemical(s) of interest, measured as time-weighted averages (TWAs), short-term exposures, or peak exposures in each occupational life cycle stage (or in a workplace scenario similar to an occupational life cycle stage).

Objective Determined during Scoping	Type of Data [a]
	Area or stationary measurements of airborne concentrations of the chemical(s) of interest in each occupational setting and life cycle stage (or in a workplace scenario similar to the life cycle stage of interest). For solids, bulk and dust particle size characterization data. Dermal exposure data. Exposure duration (hr/day). Exposure frequency (days/yr). Number of workers who potentially handle or have exposure to the chemical(s) of interest in each occupational life cycle stage. PPE types employed by the industries within scope. EC employed to reduce occupational exposures in each occupational life cycle stage (or in a workplace scenario similar to the life cycle stage of interest), and associated data or estimates of exposure reductions.
Environmental Releases (to relevant environmental media)	Description of sources of potential environmental releases, including cleaning of residues from process equipment and transport containers, involved during the manufacture, processing, or use of the chemical(s) of interest in each life cycle stage. Estimated mass (lb or kg) of the chemical(s) of interest released from industrial and commercial sites to each environmental medium (water) and treatment and disposal methods (POTW), including releases per site and aggregated over all sites (annual release rates, daily release rates) Release or emission factors. Number of release days per year. Waste treatment methods and pollution control devices employed by the industries within scope and associated data on release/emission reductions.

[a] These are the tags included in the full-text screening form. The screener makes a selection from these specific tags, which describe more specific types of data or information.
In addition to the data types listed above, EPA may identify additional data needs for mathematical modeling. These data needs will be determined on a case-by-case basis.

Abbreviations:
hr=Hour
kg=Kilogram(s)
lb=Pound(s)
yr=Year
PV=Particle volume
POTW=Publicly owned treatment works
PPE=Personal protection equipment
PSD=Particle size distribution
TWA=Time-weighted average

A.2.1.4 PESO for Fate and Transport

EPA developed a generic PESO statement to guide the screening of environmental fate data or information sources for the TSCA risk evaluations. Data or information sources that comply with the inclusion criteria in the PESO statement are eligible for inclusion, considered for evaluation, and possibly included in the environmental fate assessment. On the other hand, data or information sources that fail to meet the criteria in the PESO statement are excluded from further consideration.

Assessors seek information on various chemical-specific fate endpoints and associated fate processes, environmental media and exposure pathways as part of the process of developing the environmental fate

assessment for each risk evaluation. EPA uses the PESO statement (Table_Apx A-9) along with the information in Table_Apx A-10 when screening the fate data or information sources to ensure complete coverage of the processes, pathways and data or information relevant to the environmental fate and transport of the chemical substance undergoing risk evaluation.

Table_Apx A-9. Inclusion Criteria for Data or Information Sources Reporting Environmental Fate and Transport Data

PESO Element	Evidence
Pathways and **P**rocesses	Environmental fate, transport, partitioning and degradation behavior across environmental media to inform exposure pathways of the chemical substance of interest Exposure pathways included in the conceptual models: air, surface water, groundwater, wastewater, soil, sediment and biosolids. Processes associated with the target exposure pathways Bioconcentration and bioaccumulation Destruction and removal by incineration Please refer to the conceptual models for more information about the exposure pathways included in each TSCA risk evaluation.
Exposure	Environmental exposure of environmental receptors (*i.e.*, aquatic and terrestrial organisms) to the chemical substance of interest, mixtures including the chemical substance, and/or its degradation products and metabolites Environmental exposure of human receptors, including any PESS, to the chemical substance of interest, mixtures including the chemical substance, and/or its degradation products and metabolites Please refer to the conceptual models for more information about the environmental and human receptors included in each TSCA risk evaluation.
Setting or **S**cenario	Any setting or scenario resulting in releases of the chemical substance of interest into the natural or built environment (*e.g.*, buildings including homes or workplaces, or wastewater treatment facilities) that would expose environmental (*i.e.*, aquatic and terrestrial organisms) or human receptors (*i.e.*, general population, and PESS)
Outcomes	Fate properties which allow assessments of exposure pathways: Abiotic and biotic degradation rates, mechanisms, pathways, and products Bioaccumulation magnitude and metabolism rates Partitioning within and between environmental media (see Pathways and Processes)

Table_Apx A-10. Fate Endpoints and Associated Processes, Media and Exposure Pathways Considered in the Development of the Environmental Fate Assessment

Fate Data Endpoint	Associated Process(es)	Associated Media/Exposure Pathways			
		Surface Water, Wastewater, Sediment	Soil, Biosolids	Groundwater	Air
Required Environmental Fate Data					
Abiotic reduction rates or half-lives	Abiotic reduction, Abiotic dehalogenation	X			
Aerobic biodegradation rates or half-lives	Aerobic biodegradation	X	X		
Anaerobic biodegradation rates or half-lives	Anaerobic biodegradation	X	X	X	
Aqueous photolysis (direct and indirect) rates or half-lives	Aqueous photolysis (direct and indirect)	X			
Atmospheric photolysis (direct and indirect) rates or half-lives	Atmospheric photolysis (direct and indirect)				X
Bioconcentration factor (BCF), Bioaccumulation factor (BAF)	Bioconcentration, Bioaccumulation	X	X		X
Biomagnification and related information	Trophic magnification	X			
Desorption information	Sorption, Mobility	X	X	X	
Destruction and removal by incineration	Incineration				X
Hydrolysis rates or half-lives	Hydrolysis	X	X	X	
K_{OC} and other sorption information	Sorption, Mobility	X	X	X	
Wastewater treatment removal information	Wastewater treatment	X	X		
Supplemental (or Optional) Environmental Fate Data					
Abiotic transformation products	Hydrolysis, Photolysis, Incineration	X			X
Aerobic biotransformation products	Aerobic biodegradation	X	X		
Anaerobic biotransformation products	Anaerobic biodegradation	X	X	X	
Atmospheric deposition information	Atmospheric deposition				X
Coagulation information	Coagulation, Mobility	X		X	
Incineration removal information	Incineration				X

A.2.1.5 Generation of Hazard Heat Maps

As stated in Appendix A.1.2.2, SWIFT Review has pre-set literature search strategies ("filters") developed by information specialists that can be applied to identify studies that are more likely to be useful for identifying human health and ecotoxicity content. The filters function like a typical search strategy where studies are tagged as belonging to a certain filter if the terms in the filter literature search strategy appear in title, abstract, keyword or MeSH fields content.

After the completion of full-text screening for hazard data, all references tagged as included (or "PECO-relevant) were uploaded to the SWIFT Review tool for further filtering. The SWIFT Review filters applied at this phase focused on types of health outcomes included: "ADME", "PBPK", "cancer", "cardiovascular", "developmental", "endocrine", "gastrointestinal", "hematological and immune", "hepatic", "mortality", "musculoskeletal", "neurological", "nutritional and metabolic", "ocular and sensory", "renal", "reproductive", "respiratory", and "skin and connective tissue". The details of these health outcome search strategies that underlie the filters are available online. Studies that included one or more of the search terms in the title, abstract, keyword, or MeSH fields were exported and used to populate the Hazard Heat Map (Figure 2-10). Studies that were not retrieved using these filters were tagged as "No Tag". The evidence type listed in the heat map (*e.g.*, human, animal-human health model, animal- environmental model, and plant) was manually assigned to each reference by screeners during the full-text screening.

The health outcome tags were originally designed for vertebrate systems, and as such, did not conform well to plant evidence. Therefore, any plant studies tagged for: "cancer", "cardiovascular", "gastrointestinal", "hematological and immune", "hepatic", "musculoskeletal", "neurological", "ocular and sensory" and "renal and respiratory" were manually reviewed and re-tagged to more appropriate health outcomes.

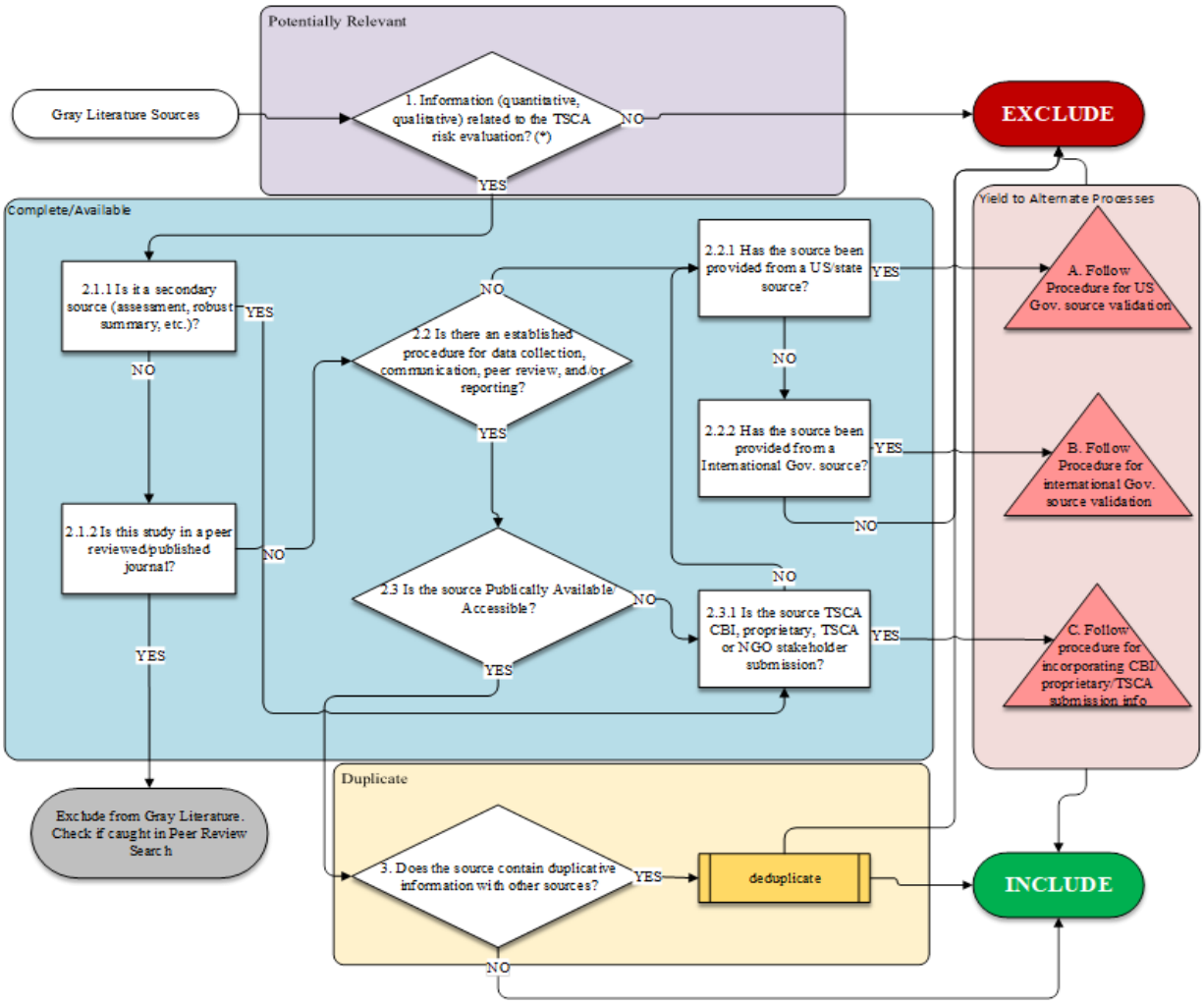
A.3 Gray Literature Search and Screening Strategies

EPA conducted a gray literature search for available information to support the TSCA risk evaluations for the next twenty TSCA risk evaluations. Gray literature is defined as the broad category of data/information sources not found in standard, peer-reviewed literature databases (*e.g.*, PubMed and Web of Science). Gray literature includes data/information sources such as white papers, conference proceedings, technical reports, reference books, dissertations, information on various stakeholder websites, and other databases. Given the nature of how gray literature is searched and collected, results may not come with a bibliographic citation or abstract and were therefore processed using a decision tree logic described in Appendix A.3.1 for potential relevance prior to entering full text screening where a discipline-specific PECO is applied.

Search terms were variable dependent on source and based on knowledge of a given source to provide discipline-specific information. A summary of sources are provided in Appendix A.3.4. The criteria for determining the potential relevance of documents identified from gray literature sources is described in the following sections for each discipline.

A.3.1 Screening of Gray Literature

To reduce the overall burden of processing gray literature results, EPA developed a screening process to determine the potential relevance of gray literature. This step was introduced prior to collecting the resulting documents. Figure_Apx A-1 describes the decision logic used to screen gray literature results.


Potentially Relevant
Gray Literature Sources
1. Information (quantitative, qualitative) related to the TSCA risk evaluation? (*)
NO
YES
EXCLUDE
Complete/Available
2.1.1 Is it a secondary source (assessment, robust summary, etc.)?
YES
NO
2.1.2 Is this study in a peer reviewed/published journal?
NO
YES
2.2 Is there an established procedure for data collection, communication, peer review, and/or reporting?
NO
YES
2.2.1 Has the source been provided from a US/state source?
YES
NO
2.2.2 Has the source been provided from a International Gov. source?
YES
NO
2.3 Is the source Publically Available/ Accessible?
NO
YES
2.3.1 Is the source TSCA CBI, proprietary, TSCA or NGO stakeholder submission?
YES
Yield to Alternate Processes
A. Follow Procedure for US Gov. source validation
B. Follow Procedure for international Gov. source validation
C. Follow procedure for incorporating CBI/ proprietary/TSCA submission info
Exclude from Gray Literature. Check if caught in Peer Review Search
Duplicate
3. Does the source contain duplicative information with other sources?
YES
NO
deduplicate
INCLUDE

Figure_Apx A-1. Decision Logic Tree Used to Screen Gray Literature Results

A.3.2 Initial Screening of Sources using Decision Logic Tree

The purpose of the inclusion/exclusion decision logic tree in Figure_Apx A-1 is to provide a broad, general screening technique to determine whether each gray literature source should be included and further screened or excluded with no additional screening necessary. The diamonds in the decision tree require analysis by the screener, whereas the rectangular boxes are used to classify the type of source. All the questions used in the decision process are provided in Table_Apx A-11**.**

Table_Apx A-11. Decision Logic Tree Overview

Step	Metric	Questions to Consider
1	Potential Relevance	Does the result have information (qualitative or quantitative) related to TSCA risk evaluations? *Apply Discipline relevancy metric
2.1.1	Complete / Available	Is it a secondary data source (assessment, robust summary, TSCA submission databases, etc.)?
2.1.2		Is the document from a peer reviewed/published journal?

Step	Metric	Questions to Consider
2.2		Is there an established procedure for data collection, communication, peer review, and/or reporting?
2.2.1		Has the data been provided by a US governmental/state source?
2.2.2		Has the data been provided by an international governmental source?
2.3		Are these data publicly available/accessible?
2.3.1		Is the source TSCA CBI, proprietary, TSCA or NGO stakeholder submission?
3	Duplicate	Does the result contain any duplicative information found in other sources?

Results of the gray literature search and decision tree process are included in Appendix A.3.4.

A.3.3 TSCA Submission Searching and Title Screening

EPA screens information submitted under TSCA Sections 4, 5, 8(e), and 8(d), as well as for your information (FYI) submissions. In the gray literature process defined in Appendix A.3.2, EPA considers the databases that contain TSCA submissions to be secondary sources (Step 1.1) because the metadata in the databases are secondary. These databases then advance to Step 2.3.1 and then to Process C. The Process C steps are described here.

EPA first screens the titles using two screeners per title. EPA conducts this step primarily to reduce the number of full studies to be obtained because some studies are available only on microfiche or in long-term storage. Screening is done using the inclusion and exclusion criteria within the relevant PECOs, PESOs or RESOs for each topic area (Appendix A.2.1). EPA excludes interim reports (*e.g.*, interim sacrifices for toxicity studies) and only final reports are further considered. If the title is not clear regarding the document's contents, EPA obtains the full text and advances to the next steps.

After full texts are obtained, EPA reviews some sources (prior to full-text screening) based on whether they have several factors; primary data, an established procedure for peer review, data collection, communication and/or reporting and are publicly available. Sources that have these factors will move on to full text screening. Other sources will go straight to full text screening using PECO-type criteria without going through this extra step.

EPA may decide to initiate a backwards search on sources that are deemed to have secondary data. In situations where parameters such as procedures for peer review and data collection are unclear, EPA may reach out to the authors to retrieve information to gauge whether the source should be included or excluded. Studies that are not publicly available (such as proprietary or CBI sources) may undergo additional screening steps.

During the full-text screening step, two individuals screen each source according to the PECOs, PESOs and RESOs (Appendix A.2.1).

Results of the TSCA submission search and decision tree process are included in Appendix A.3.4.

A.3.4 Gray Literature Search Results for *trans*-1,2,-Dichloroethylene

Table_Apx A-12 provides a list of gray literature sources that yielded results for *trans*-1,2-dichloroethylene.

Table_Apx A-12. Gray Literature Sources That Yielded Results for *trans*-1,2-Dichloroethylene

Source Agency	Source Name	Source Type	Source Category	Source Website
ATSDR	ATSDR Tox Profile Updates and Addendums	Other US Agency Resources	Assessment or Related Document	https://www.atsdr.cdc.gov/toxprofiles/profilesaddenda.asp
ATSDR	ATSDR Toxicological Profiles (original publication)	Other US Agency Resources	Assessment or Related Document	https://www.atsdr.cdc.gov/toxprofiles/index.asp
CAL EPA	Technical Support Documents for regulations: Drinking Water Public Health Goals	Other US Agency Resources	Assessment or Related Document	https://oehha.ca.gov/chemicals
CAL EPA	Technical Support Documents for regulations: Soil Screening	Other US Agency Resources	Assessment or Related Document	https://oehha.ca.gov/chemicals
CDC	CDC Biomonitoring Tables	Other US Agency Resources	Database	https://www.cdc.gov/exposure%20report/index.html/
ECHA	ECHA Documents	International Resources	Assessment or Related Document	https://echa.europa.eu/information-on-chemicals
Env Canada	Chemicals at a Glance (fact sheets)	International Resources	Assessment or Related Document	https://www.canada.ca/en/health-canada/services/chemical-substances/fact-sheets/chemicals-glance.html
EPA	OPPT: TSCATS database maintained at SRC (TSCA submissions)	US EPA Resources	Database	
EPA	OPPT: Chemview (TSCA submissions - chemical test rule data and substantial risk reports)	US EPA Resources	Database	https://chemview.epa.gov/chemview
EPA	OPPT: CIS (CBI LAN) (TSCA submissions)	US EPA Resources	Database	Confidential Business Information
EPA	Office of Water: STORET and WQX	US EPA Resources	Database	https://www.waterqualitydata.us/portal/
EPA	Support document for AEGLS	US EPA Resources	Assessment or Related Document	https://www.epa.gov/aegl/access-acute-exposure-guideline-levels-aegls-values

Source Agency	Source Name	Source Type	Source Category	Source Website
EPA	IRIS Tox Review	US EPA Resources	Assessment or Related Document	https://cfpub.epa.gov/ncea/iris2/atoz.cfm
EPA	EPA Office of Water: Ambient Water Quality Criteria documents	US EPA Resources	Assessment or Related Document	https://www.epa.gov/wqc
EPA	IRIS Summary	US EPA Resources	Assessment or Related Document	https://cfpub.epa.gov/ncea/iris_drafts/atoz.cfm?list_type=alpha
EPA	TSCA Hazard Characterizations	US EPA Resources	Assessment or Related Document	https://ofmpub.epa.gov/oppthpv/hpv_hc_characterization.get_report_by_cas?doctype=2
EPA	Other EPA: Misc sources	US EPA Resources	General Search	https://www.epa.gov/
EPA	EPA: AP-42	US EPA Resources	Regulatory Document or List	https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emissions-factors
EPA	EPA Ambient Monitoring Technology Information Center – Air Toxics Data	US EPA Resources	Database	https://www3.epa.gov/ttnamti1/toxdat.html
EPA	Office of Water: Drinking Water Standards Health Effects Support Documents	US EPA Resources	Regulatory Document or List	https://www.epa.gov/eg
EPA	Office of Water: CFRs	US EPA Resources	Regulatory Document or List	https://www.epa.gov/eg
EPA	Office of Air: CFRs and Dockets	US EPA Resources	Regulatory Document or List	https://www.epa.gov/stationary-sources-air-pollution
EPA	EPA: Generic Scenario	US EPA Resources	Assessment or Related Document	https://www.epa.gov/tsca-screening-tools/chemsteer-chemical-screening-tool-exposures-and-environmental-releases#genericscenarios
Japan	Japanese Ministry of the Environment Assessments - Environmental Risk Assessments (Class I Designated Chemical Substances Summary Table)	International Resources	Regulatory Document or List	https://www.env.go.jp/en/chemi/prtr/substances/
ILO	International Chemical Safety Cards (ICSCs)	International Resources	Database	https://www.ilo.org/safework/info/publications/WCMS_113134/lang--en/index.htm

Source Agency	Source Name	Source Type	Source Category	Source Website
KOECT	Kirk-Othmer Encyclopedia of Chemical Technology Journal Article	Other Resource	Encyclopedia	https://onlinelibrary.wiley.com/doi/book/10.1002/0471238961
NIOSH	CDC NIOSH - Health Hazard Evaluations (HHEs)	Other US Agency Resources	Assessment or Related Document	https://www2a.cdc.gov/hhe/search.asp
NIOSH	CDC NIOSH - Publications and Products	Other US Agency Resources	Assessment or Related Document	https://www2a.cdc.gov/nioshtic-2/
NTP	Additional NTP Reports	Other US Agency Resources	Assessment or Related Document	https://ntp.niehs.nih.gov/publications/index.html
OECD	OECD Emission Scenario Documents	International Resources	Assessment or Related Document	http://www.oecd.org/document/46/0,2340,en_2649_201185_2412462_1_1_1_1,00.html
OECD	OECD: General Site	International Resources	General Search	https://www.oecd.org/
RIVM	RIVM Reports: Risk Assessments	International Resources	Assessment or Related Document	https://www.rivm.nl/en
TERA	Toxicology Excellence for Risk Assessment	Other Resources	Assessment or Related Document	https://tera.org/

Appendix B PHYSICAL AND CHEMICAL PROPERTIES OF *trans*-1,2-DICHLOROETHYLENE

Table_Apx B-1 summarizes statistics for the physical and chemical property values identified through systematic review as of June 2020. The "N" column indicates the number of unique primary sources of data for that endpoint. That is, if multiple sources presented equivalent values and cited the same primary source, only one of those was included in these statistics and included in the statistical calculations. All physical and chemical property values that were extracted and evaluated as of June 2020 are presented in the supplemental file *Data Extraction and Data Evaluation Tables for Physical and Chemical Property Studies* (EPA-HQ-OPPT-2018-0465).

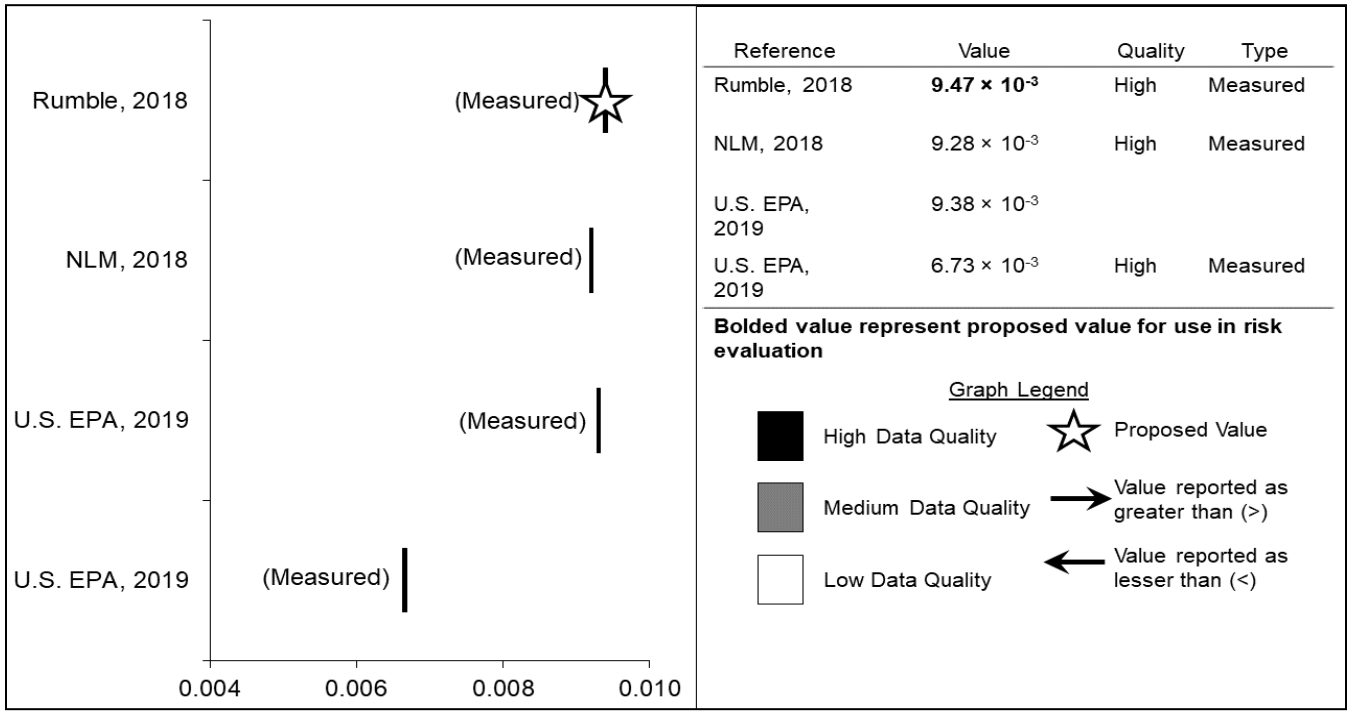
Table_Apx B-1. Summary Statistics for Reviewed Physical Properties

Property or Endpoint	N	Unit	Mean	Standard Deviation	Min	Max
Molecular formula	-	-	NA	NA	NA	NA
Molecular weight	-	g/mol	NA	NA	NA	NA
Physical state	5	-	NA	NA	NA	NA
Physical properties	3	-	NA	NA	NA	NA
Melting point	14	ºC	-57.4	11.1	-80	-49.4
Boiling point	15	ºC	50	4.5	47	60
Density	8	g/cm^3	1.253	0.011	1.228	1.265
Vapor pressure	7	mm Hg	292	72.3	180	410
Vapor density	1	-	3.67		3.67	3.67
Water solubility	13	mg/L	4968	854.2	4000	6301
Octanol/water partition coefficient (log Kow)	9	-	2.55	0.74	1.51	3.43
Henry's Law constant	4	$atm \cdot m^3/mol$	0.008715	0.0013256	0.00673	0.00947
Flash point	0	ºC	-	-	-	-
Auto flammability	0	ºC	-	-	-	-
Viscosity	4	cP	0.422	0.107	0.317	0.57
Refractive index	6	-	1.4456	0.0036	1.4399	1.4514
Dielectric constant	1	-	2.35		2.35	2.35

NA = Not applicable

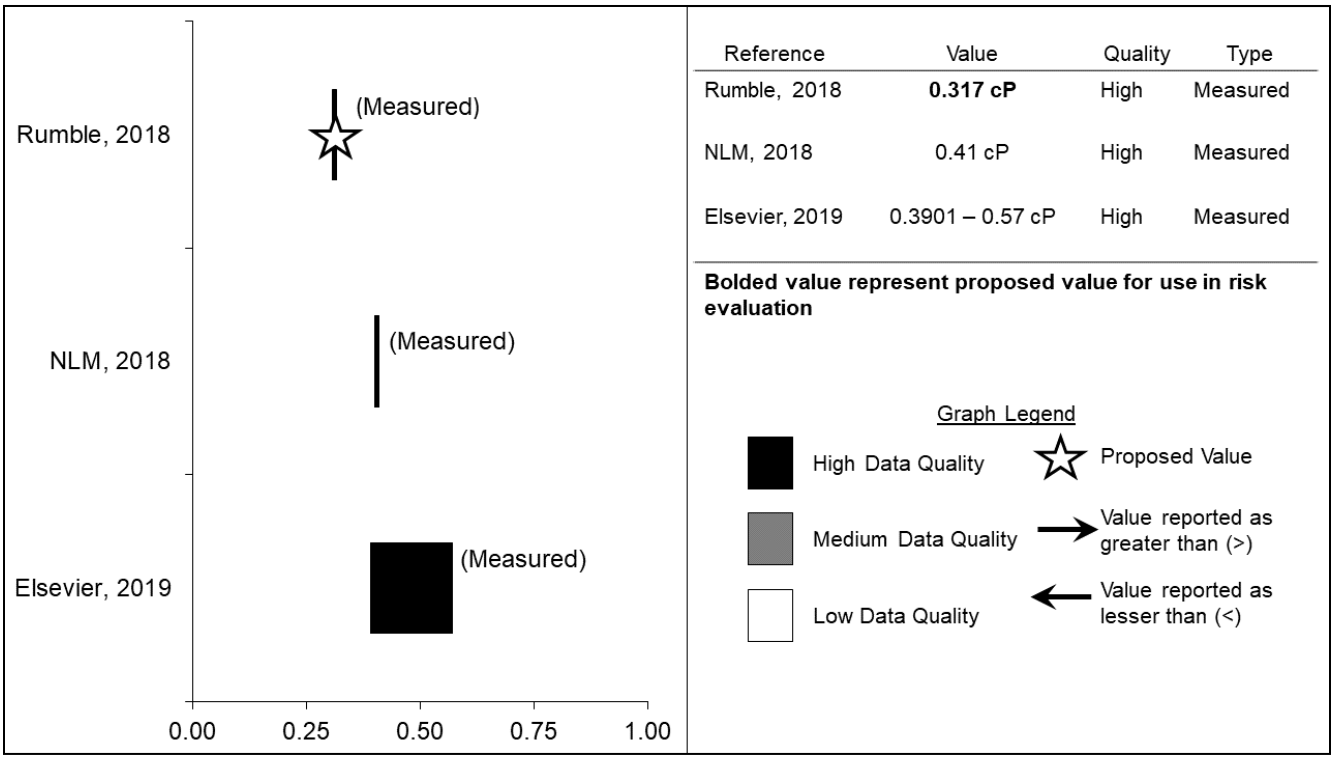
The preliminarily selected value for the Henry's law constant lies outside the 95% confidence interval, defined as ±2 standard deviations from the mean under the assumption that the data are normally distributed (see Figure 2-12.). The lowest reported value (6.73×10^{-3} $atm \cdot m^3/mol$) (U.S. EPA, 2020b) does not include a reported temperature at which the Henry's law constant was measured, and if it was measured at a low temperature that may explain why it differs from the other reported values. The two intermediate values were measured at 24°C, and the selected value was measured at 25°C. Information

about all reported Henry's law constant values are summarized in Figure_Apx B-1 and presented in the supplemental file *Data Extraction and Data Evaluation Tables for Physical and Chemical Property Studies* (EPA-HQ-OPPT-2018-0465).



Figure_Apx B-1. Tornado Diagram for Henry's Law Constant Data Identified in Systematic Review

The preliminarily selected value for viscosity also lies outside the 95% confidence interval (see Figure 2-12.). EPA will attempt to obtain and assess the primary sources of these viscosity values before identifying the final selected value for risk evaluation. Information about all reported viscosity values are summarized in Figure_Apx B-2 and presented in the supplemental file *Data Extraction and Data Evaluation Tables for Physical and Chemical Property Studies* (EPA-HQ-OPPT-2018-0476).



Figure_Apx B-2. Tornado Diagram for Viscosity Data Identified in Systematic Review

Appendix C ENVIRONMENTAL FATE AND TRANSPORT PROPERTIES OF *trans*-1,2-DICHLOROETHYLENE

Table_Apx C-1 provides the environmental fate characteristics that EPA identified and considered in developing the scope for *trans*-1,2-dichloroethylene. This information was presented in the *Proposed Designation of trans-1,2-Dichloroethylene (CASRN 156-60-5) as a High-Priority Substance for Risk Evaluation* (U.S. EPA, 2019d) and may be updated as EPA collects additional information through systematic review methods.Table Apx C-1 provides the environmental fate characteristics that EPA identified and considered in developing the scope for *trans*-1,2-dichloroethylene. This information was presented in the *Proposed Designation of trans-1,2-dichloroethylene (CASRN 156-60-5) as a High-Priority Substance for Risk Evaluation* (U.S. EPA, 2019d) and may be updated as EPA collects additional information through systematic review methods.

Table_Apx C-1. Environmental Fate Properties of *trans*-1,2-Dichloroethylene

Property or Endpoint	Value[a]	Reference
Direct Photodegradation	UV absorption at <240 nm with minor absorption between 290 and 380 nm; direct photolysis is not expected to be an important fate process	ATSDR (1996); NLM (2018)
Indirect Photodegradation	$t_{1/2}$ = 5 days (based on·OH reaction rate constant of 4.5 × 10^{-12} cm^3/mol·second at 25 °C)	ATSDR (1996) citing Goodman (1986)
	$t_{1/2}$ = 44 days (based on ozone reaction rate)	ATSDR (1996) citing Tuazon et al. (1984)
	$t_{1/2}$ = 6.9 hours (based on OH reaction rate constant of 2.34 × 10^{-12} cm^3/mol·second at 25 °C and 5 × 10^5·OH radicals/cm^3)	NLM (2018) citing Kwok and Atkinson (1994)
	$t_{1/2}$ = 57 days (based on ozone reaction rate of 2.0 × 10^{-19} cm^3/mol·second and 7 × 10^{11} ozone molecules/cm^3 at 25 °C)	NLM (2018) citing Kwok and Atkinson (1994)
	$t_{1/2}$ = 310 days (based on nitrate reaction rate of 1.07 × 10^{-16} cm^3/mol·second at 25 °C and 2.4 × 10^8 nitrate radicals/cm^3)	NLM (2018) citing Kwok and Atkinson (1994)
Hydrolysis	Stable; *trans*-1,2-dichloroethylene is not expected to undergo hydrolysis based on its chemical structure, which lacks functional groups known to undergo hydrolysis under environmental conditions	NLM (2018) citing Callahan et al. (1979)
Biodegradation (Aerobic)	Water: 0% after 28 days based on BOD (Japanese MITI test)	NITE (2018); NLM (2018)

Property or Endpoint	Value[a]	Reference
	Water: 0%/time not specified (river die-away test and shake-flask test)	NLM (2018) citing Mudder and Musterman (1982); Mudder (1981)
	Water: 67%/7 days with 33% loss due to volatilization in 10 days (enrichment biodegradability screening test with wastewater inoculum; test substance concentration of 5 ppm)	NLM (2018) citing Fogel et al. (1986)
	Soil and water: Durban, KwaZulu-Natal, South Africa $t_{1/2}$ = 21 days in soil A (52% sand, 26.5% clay, 21.5% silt, microbial concentration 6.5 × 105cfu/g) $t_{1/2}$ = 23 days in soil B (80.25% sand, 8.25% clay, 11.5% silt, microbial concentration 3.0 × 10^5 cfu/g) $t_{1/2}$ = 27 days in water A (pH 6.98, microbial concentration 13.25 × 10^5 cfu/g) $t_{1/2}$ = 26 days in water B (pH 6.94, microbial concentration 3.4 × 10^5 cfu/g)	NLM (2018) citing Olaniran et al. (2006)
Biodegradation (Anaerobic)	18%/40 weeks (serum bottle) vinyl chloride was the primary degradation product	NLM (2018) citing Wilson et al. (1986)
	73%/6 months (microcosms with uncontaminated organic sediment from the Everglades); vinyl chloride was the degradation product	NLM (2018) citing Barrio-Lage et al. (1986)
Wastewater Treatment	$t_{1/2}$ = 24 minutes by evaporation from water (1 ppm aqueous solution with still air, an average depth of 6.5 cm, at 25 °C) 90% evaporation after 83 minutes (1 ppm solution at 25 °C)	NLM (2018) citing Verschueren (2001)
	79% total removal (0.04% by biodegradation, 0.90% by sludge and 78% by volatilization to air; estimated)[b]	U.S. EPA (2012b)
Bioconcentration Factor	11 (estimated)[b]	U.S. EPA (2012b)
Bioaccumulation Factor	13 (estimated)[b]	U.S. EPA (2012b)

Property or Endpoint	Value[a]	Reference
Soil Organic Carbon: Water Partition Coefficient (Log K_{OC})	1.77 (K_{OC} = 59)	NLM (2018) citing Mackay et al. (2006); Chu and Chan (2000)

[a] Measured unless otherwise noted
[b] EPI Suite™ physical property inputs: Log K_{OW} = 2.09, BP = 48.7 ºC, MP = –49.8 ºC, VP = 331 mm Hg, WS = 4,520 mg/L, SMILES C(=CCl)Cl.
·OH = hydroxyl radical; MITI = Ministry of International Trade and Industry; BOD = biochemical oxygen demand

Appendix D REGULATORY HISTORY

The chemical substance, *trans*-1,2-dichloroethylene (trans-DCE), is subject to federal and state laws and regulations in the United States (Table_Apx D-1 and Table_Apx D-2). Regulatory actions by other governments, tribes and international agreements applicable to *trans*-1,2-dichloroethylene are listed in Table_Apx D-3.

D.1 Federal Laws and Regulations

Table_Apx D-1. Federal Laws and Regulations

Statutes/Regulations	Description of Authority/Regulation	Description of Regulation
EPA Statutes/Regulations		
Toxic Substances Control Act (TSCA) – Section 6(b)	EPA is directed to identify high-priority chemical substances for risk evaluation; and conduct risk evaluations on at least 20 high priority substances no later than three and one-half years after the date of enactment of the Frank R. Lautenberg Chemical Safety for the 21st Century Act.	*trans*-DCE is one of the 20 chemicals EPA designated as a High-Priority Substance for risk evaluation under TSCA (84 FR 71924, December 30, 2019). Designation of *trans*-DCE as high-priority substance constitutes the initiation of the risk evaluation on the chemical.
Toxic Substances Control Act (TSCA) – Section 8(a)	The TSCA Section 8(a) CDR Rule requires manufacturers (including importers) to give EPA basic exposure-related information on the types, quantities and uses of chemical substances produced domestically and imported into the United States.	*trans*-DCE manufacturing (including importing), processing and use information is reported under the CDR rule (85 FR 20122, April 2, 2020).
Toxic Substances Control Act (TSCA) – Section 8(b)	EPA must compile, keep current and publish a list (the TSCA Inventory) of each chemical substance manufactured (including imported) or processed in the United States.	*trans*-DCE was on the initial TSCA Inventory and therefore was not subject to EPA's new chemicals review process under TSCA Section 5 (60 FR 16309, March 29, 1995).
Toxic Substances Control Act (TSCA) – Section 8(d)	Provides EPA with authority to issue rules requiring producers, importers, and (if specified) processors of a chemical substance or mixture to submit lists and/or copies of ongoing and completed, unpublished health and safety studies.	4 health and safety studies received for *trans*-DCE (1994) (U.S. EPA, ChemView, Accessed April 18, 2019).

Statutes/Regulations	Description of Authority/Regulation	Description of Regulation
Toxic Substances Control Act (TSCA) – Section 8(e)	Manufacturers (including importers), processors, and distributors must immediately notify EPA if they obtain information that supports the conclusion that a chemical substance or mixture presents a substantial risk of injury to health or the environment.	Two risk reports received for *trans*-DCE (1994; 2000) (U.S. EPA, ChemView, Accessed April 4, 2019).
Emergency Planning and Community Right-To-Know Act (EPCRA) – Section 313	Requires annual reporting from facilities in specific industry sectors that employ 10 or more full-time equivalent employees and that manufacture, process or otherwise use a TRI-listed chemical in quantities above threshold levels. A facility that meets reporting requirements must submit a reporting form for each chemical for which it triggered reporting, providing data across a variety of categories, including activities and uses of the chemical, releases and other waste management (*e.g.*, quantities recycled, treated, combusted) and pollution prevention activities (under Section 6607 of the Pollution Prevention Act). These data include on- and off-site data as well as multimedia data (*i.e.*, air, land and water).	DCE (mixture of the cis & trans isomers; CAS 540-59-0) is a listed substance subject to reporting requirements under 40 CFR 372.65 effective as of January 01, 1987.
Clean Air Act (CAA) – Section 612	Under Section 612 of the CAA, EPA's Significant New Alternatives Policy (SNAP) program reviews substitutes for ozone-depleting substances within a comparative risk framework. EPA publishes lists of acceptable and unacceptable alternatives. A determination that an alternative is unacceptable, or acceptable only with conditions, is made through rulemaking.	Under the SNAP program, EPA listed *trans*-DCE as an acceptable substitute for methyl chloroform and CFC-113 in metals, electronics, and precision cleaning and in aerosol solvents (59 FR 44240, August 26, 1994). Later, EPA listed *trans*-DCE as an acceptable substitute for methyl chloroform and CFC-113 in adhesives (61 FR 47012, September 5, 1996). EPA also listed Transcend™ Technologies, which contains *trans*-DCE, when used as an additive to other SNAP-

Statutes/Regulations	Description of Authority/Regulation	Description of Regulation
		approved foam blowing agents, in blends making up to 5% by weight of the total foam formulation, as a substitute for CFCs and HCFCs in a number of polyurethane foam end-uses (71 FR 15589, March 29, 2006). Most recently, EPA has also listed the refrigerant blend HFO-1336mzz(Z)/ dichloroethylene blend (74.7/25.3) (also known as R-514A), which contains 25.3 percent *trans*-DCE by weight, as acceptable for use in centrifugal chillers and positive displacement chillers (81 FR 32241, May 23, 2016).
Clean Water Act (CWA) - Section 304(a)(1)	Requires EPA to develop and publish ambient water quality criteria (AWQC) reflecting the latest scientific knowledge on the effects on human health that may be expected from the presence of pollutants in any body of water.	In 2015, EPA published updated AWQC for *trans*-DCE, including a recommendation of 100 (µg/L) for "Human Health for the consumption of Water + Organism" and 4000 (µg/L) for "Human Health for the consumption of Organism Only" for states and authorized tribes to consider when adopting criteria into their water quality standards. [EPA-HQ-OW-2014-0135-0249]
Clean Water Act (CWA) – Section 301, 304, 306, 307, and 402	Clean Water Act Section 307(a) establishes a list of toxic pollutants or combination of pollutants under the CWA. The statute specifies a list of families of toxic pollutants also listed in the Code of Federal Regulations at 40 CFR Part 401.15. The "priority pollutants" specified by those families are listed in 40 CFR Part 423 Appendix A. These are pollutants for which best available technology effluent limitations must be established on either a national basis through rules (Sections 301(b),	*trans*-DCE is designated as a toxic pollutant under Section 307(a)(1) of the CWA and as such is subject to effluent limitations. Under CWA Section 304, *trans*-DCE is included in the list of total toxic organics (TTO) (40 CFR 413.02(i)).

Statutes/Regulations	Description of Authority/Regulation	Description of Regulation
	304(b), 307(b), 306) or on a case-by-case best professional judgement basis in NPDES permits, see Section 402(a)(1)(B). EPA identifies the best available technology that is economically achievable for that industry after considering statutorily prescribed factors and sets regulatory requirements based on the performance of that technology.	
Safe Drinking Water Act (SDWA) – Section 1412	Requires EPA to publish a non-enforceable maximum contaminant level goal (MCLG) for a contaminant for which EPA makes the determination that the contaminant: 1. may have an adverse effect on the health of persons; 2. is known to occur or there is a substantial likelihood that the contaminant will occur in public water systems with a frequency and at levels of public health concern; and 3. in the sole judgement of the Administrator, regulation of the contaminant presents a meaningful opportunity for health risk reductions for persons served by public water systems. When EPA publishes an MCLG, EPA must also promulgate a National Primary Drinking Water Regulation (NPDWR) which includes either an enforceable maximum contaminant level (MCL), or a required treatment technique. Public water systems are required to comply with NPDWRs.	*trans*-DCE is subject to NPDWR under the SDWA with a MCLG of 100 ppb and an enforceable MCL of 100 ppb (Section 1412).
Resource Conservation and Recovery Act (RCRA) – Section 3001	Directs EPA to develop and promulgate criteria for identifying the characteristics of hazardous waste, and for listing hazardous waste, taking into account toxicity, persistence, and degradability in nature, potential for accumulation in tissue and other related factors such as flammability, corrosiveness, and other hazardous characteristics.	*trans*-DCE is included on the list of hazardous wastes pursuant to RCRA 3001. RCRA Hazardous Waste Code: U079, FO24, and F025 (40 CFR 261.33).

Statutes/Regulations	Description of Authority/Regulation	Description of Regulation
Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) – Sections 102(a) and 103	Authorizes EPA to promulgate regulations designating as hazardous substances those substances which, when released into the environment, may present substantial danger to the public health or welfare or the environment. EPA must also promulgate regulations establishing the quantity of any hazardous substance the release of which must be reported under Section 103. Section 103 requires persons in charge of vessels or facilities to report to the National Response Center if they have knowledge of a release of a hazardous substance above the reportable quantity threshold.	*trans*-DCE is a hazardous substance under CERCLA. Releases of *trans*-DCE in excess of 1,000 pounds must be reported (40 CFR 302.4) .
Superfund Amendments and Reauthorization Act (SARA) –	Requires the Agency to revise the hazardous ranking system and update the National Priorities List of hazardous waste sites, increases state and citizen involvement in the superfund program and provides new enforcement authorities and settlement tools.	*trans*-DCE is listed on SARA, an amendment to CERCLA and the CERCLA Priority List of Hazardous Substances. This list includes substances most commonly found at facilities on the CERCLA National Priorities List (NPL) that have been deemed to pose the greatest threat to public health (atsdr.cdc.gov/SPL/).
Other Federal Statutes/Regulations		
Occupational Safety and Health Act (OSHA)	Requires employers to provide their workers with a place of employment free from recognized hazards to safety and health, such as exposure to toxic chemicals, excessive noise levels, mechanical dangers, heat or cold stress or unsanitary conditions (29 U.S.C Section 651 et seq.). Under the Act, OSHA can issue occupational safety and health standards including such provisions as Permissible Exposure Limits (PELs), exposure monitoring, engineering and	In 1971, OSHA issued occupational safety and health standards for DCE (mixture of the cis & trans isomers; CAS 540-59-0) that included a PEL of 200 ppm TWA, exposure monitoring, control measures and respiratory protection (29 CFR 1910.1000). OSHA has recognized that many of its PELs are outdated and inadequate for ensuring the protection of worker health

Statutes/Regulations	Description of Authority/Regulation	Description of Regulation
	administrative control measures, and respiratory protection.	(OSHA PELs).
Federal Hazardous Materials Transportation Act (HMTA)	Section 5103 of the Act directs the Secretary of Transportation to: • Designate material (including an explosive, radioactive material, infectious substance, flammable or combustible liquid, solid or gas, toxic, oxidizing or corrosive material, and compressed gas) as hazardous when the Secretary determines that transporting the material in commerce may pose an unreasonable risk to health and safety or property. • Issue regulations for the safe transportation, including security, of hazardous material in intrastate, interstate and foreign commerce.	*trans*-DCE is listed as a hazardous material with regard to transportation and is subject to regulations prescribing requirements applicable to the shipment and transportation of listed hazardous materials (70 FR 34381, June 14 2005).

D.2 State Laws and Regulations

Table_Apx D-2. State Laws and Regulations

State Actions	Description of Action
State Air Regulations	Allowable **Ambient Levels: New Hampshire (Env-A 1400: Regulated Toxic Air Pollutants).** Rhode Island (Air Pollution Regulation No. 22). (Air Pollution Regulation No. 22).
State Drinking Water Standards and Guidelines	Arizona (14 Ariz. Admin. Register 2978, August 1, 2008) , California (Cal Code Regs. Title 26, § 22-64444) , Delaware (Del. Admin. Code Title 16, § 4462), Connecticut (Conn. Agencies Regs. § 19-13-B102) , Maine (10 144 Me. Code R. Chap. 231) , Massachusetts (310 Code Mass. Regs. § 22.00) , Michigan (Mich. Admin. Code r.299.44 and r.299.49, 2017) , Minnesota (Minn R. Chap. 4720) , New Jersey (7:10 N.J Admin. Code § 5.2) , Pennsylvania (25 Pa. Code § 109.202) , Rhode Island (Rules and Regulations Pertaining to Public Drinking Water R46-13-DWQ), Texas (30 Tex. Admin. Code § 290.104).

State Actions	Description of Action
State PELs	California PEL for DCE mixture (CAS 540-59-0) of 200 ppm (Cal Code Regs. Title 8, § 5155) . Hawaii PEL DCE mixture (CAS 540-59-0) of 200 ppm (Hawaii Administrative Rules Section 12-60-50).
State Right-to-Know Acts	Massachusetts (105 Code Mass. Regs. § 670.000 Appendix A) , New Jersey (N.J.A.C. 7:1G) N.J.A.C. 7:1G and Pennsylvania (P.L. 734, No. 159 and 34 Pa. Code § 323).
Chemicals of High Concern to Children	Several states have adopted reporting laws for chemicals in children's products containing *trans*-DCE, including Minnesota (Toxic Free Kids Act Minn. Stat. 116.9401 to 116.9407). For a complete list of chemicals of high concern: Chemicals of High Concern
Other	*trans*-DCE is listed as a Candidate Chemical under California's Safer Consumer Products Program established under Health and Safety Code § 25252 and 25253 (California, Candidate Chemicals List. Accessed April 18, 2019). California lists *trans*-DCE as a designated priority chemical for biomonitoring under criteria established by California SB 1379 (Biomonitoring California, Priority Chemicals, February 2019). *trans*-DCE is on the MA Toxic Use Reduction Act (TURA) list of 2019 (301 CMR 41.00).

D.3 International Laws and Regulations

Table_Apx D-3. Regulatory Actions by other Governments, Tribes, and International Agreements

Country/ Organization	Requirements and Restrictions
Canada	*trans*-DCE is on the Domestic Substances List. (Government of Canada. Managing substances in the environment. Substances search. Database accessed April 12, 2019). Canadian List of Toxic Substances
European Union	*trans*-DCE is registered in the European Union under regulation (EC) No 1907/2006 - REACH (Registration, Evaluation, Authorization and Restriction of Chemicals). (European Chemicals Agency (ECHA) database, Accessed April 12, 2019).
Australia	*trans*-DCE was assessed under Human Health Tier I of the Inventory Multi-Tiered Assessment and Prioritisation (IMAP). (National Industrial

Country/ Organization	Requirements and Restrictions
	Chemicals Notification and Assessment Scheme (NICNAS). Chemical inventory, Accessed April 12, 2019). NICNAS
Japan	*trans*-DCE is regulated in Japan under the following legislation: Act on the Evaluation of Chemical Substances and Regulation of Their Manufacture, etc. (Chemical Substances Control Law; CSCL) Act on Confirmation, etc. of Release Amounts of Specific Chemical Substances in the Environment and Promotion of Improvements to the Management Thereof Industrial Safety and Health Act (ISHA) Air Pollution Control Law (Accessed April 10, 2019.)
Belgium, Canada, Denmark, Finland, Germany, Switzerland	Occupational exposure limits for t*rans*-DCE (GESTIS International limit values for chemical agents (Occupational exposure limits, OELs database, Accessed April 16, 2019).

Appendix E PROCESS, RELEASE AND OCCUPATIONAL EXPOSURE INFORMATION

This appendix provides information and data found in preliminary data identification and evaluation for *trans*-1,2-dichloroethylene.

E.1 Process Information

Process-related information potentially relevant to the risk evaluation may include process diagrams, descriptions and equipment. Such information may inform potential release sources and worker exposure activities.

E.1.1 Manufacture (Including Import)

E.1.1.1 Manufacture

trans-1,2-Dichloroethylene can be produced by direct chlorination of acetylene at 40 degrees C. It is often produced as a by-product in the chlorination of chlorinated compounds and recycled as an intermediate for the synthesis of more useful chlorinated ethylenes. *trans*-1,2-Dichloroethylene can also be formed by continuous oxychlorination of ethylene by use of a cupric chloride–potassium chloride catalyst, as the first step in the manufacture of vinyl chloride (Snedecor et al., 2004).

E.1.1.2 Import

Commodity chemicals such as *trans*-1,2-dichloroethylene may be imported into the United States in bulk via water, air, land, and intermodal shipments (Tomer and Kane, 2015). These shipments take the form of oceangoing chemical tankers, railcars, tank trucks, and intermodal tank containers. Chemicals shipped in bulk containers may be repackaged into smaller containers for resale, such as drums or bottles. Domestically manufactured commodity chemicals may be shipped within the United States in liquid cargo barges, railcars, tank trucks, tank containers, intermediate bulk containers (IBCs)/totes, and drums. Both imported and domestically manufactured commodity chemicals may be repackaged by wholesalers for resale; for example, repackaging bulk packaging into drums or bottles. The type and size of container will vary depending on customer requirement. In some cases, QC samples may be taken at import and repackaging sites for analyses. Some import facilities may only serve as storage and distribution locations, and repackaging/sampling may not occur at all import facilities.

In the 2016 CDR, one company reported importing a formulation containing less than 1 percent *trans*-1,2-dichloroethylene (U.S. EPA, 2019b).

E.1.2 Processing and Distribution

E.1.2.1 Processing as a Reactant

Processing as a reactant or intermediate is the use of *trans*-1,2-dichloroethylene as a feedstock in the production of another chemical via a chemical reaction in which *trans*-1,2-dichloroethylene is consumed to form the product. At least one company markets *trans*-1,2-dichloroethylene as "a source of pure hydrochloric acid through a controlled decomposition process in the electronics industry manufacturing and etching of silicon chips" (Axiall, 2016). EPA plans to evaluate this, and any other similar, condition of use as more information becomes available.

E.1.2.2 Incorporation into Formulation, Mixture, or Reaction Product

Incorporation into formulation, mixture or reaction product refers to the process of mixing or blending of several raw materials to obtain a product or mixture. *trans*-1,2-Dichloroethylene can be incorporated

into solvents for cleaning or degreasing, adhesives and sealants, foam blowing additives, and as a carrier solvent in other product formulations.

Formation processes specific to *trans*-1,2-dichloroethylene were not identified; however, several OECD ESDs provide general process descriptions for some of these types of products. For example, adhesive formulation involves mixing together volatile and non-volatile chemical components in sealed, unsealed or heated processes (OECD, 2009). Sealed processes are most common for adhesive formulation because many adhesives are designed to set or react when exposed to ambient conditions (OECD, 2009). Lubricant formulation typically involves the blending of two or more components, including liquid and solid additives, together in a blending vessel (OECD, 2004).

E.1.2.3 Incorporation into Articles

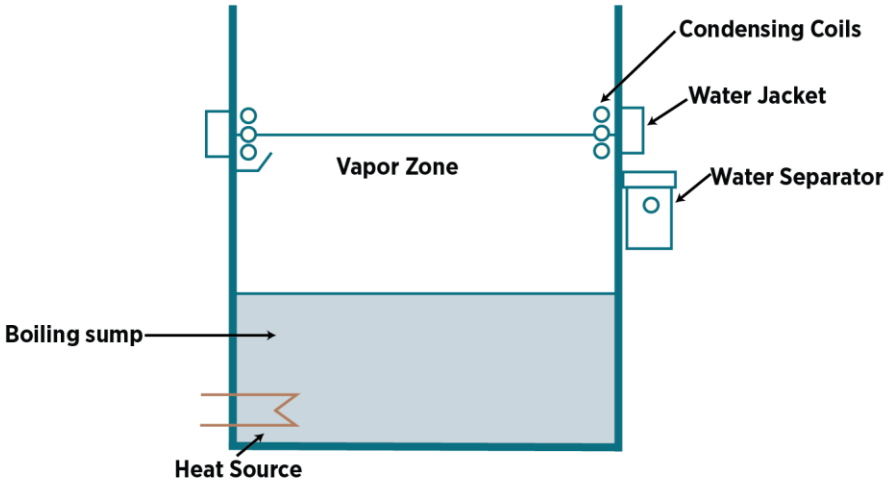
Incorporation into an article typically refers to a process in which a chemical becomes an integral component of an article that is distributed for industrial, trade, or consumer use. Exact process operations involved in the incorporation of *trans*-1,2-dichloroethylene are dependent on the article. Types of articles identified include, but are not limited to, plastic products and flexible polyurethane foams (U.S. EPA, 2019b). EPA plans to evaluate the potential use of *trans*-1,2-dichloroethylene in this type of process during the risk evaluation.

E.1.3 Uses

E.1.3.1 Batch Open-Top Vapor Degreasing

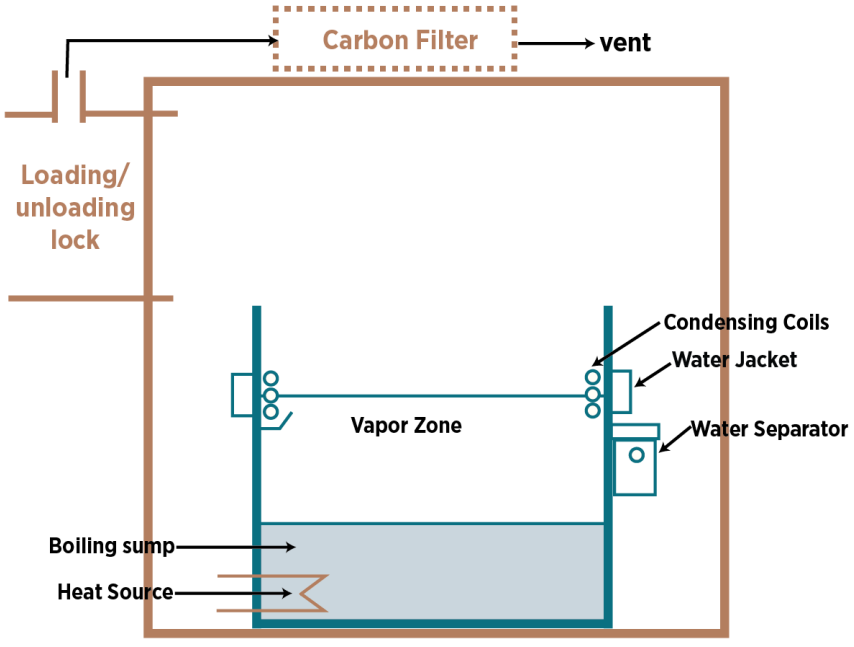
trans-1,2-Dichloroethylene is a component in vapor degreasing formulations. A commenter (EPA-HQ-OPPT-2019-0131-0042) provided descriptions of their use of *trans*-1,2-dichloroethylene used as a nonflammable solvent for cleaning hydraulic load control system components, which the commenter also indicated was a critical use, further informing EPA's understanding of this condition of use. Appendix E.1.3.1 and Appendix E.1.3.2 provide example process description for batch vapor degreasing systems.

In batch open top vapor degreasers (OTVDs), a vapor cleaning zone is created by heating the liquid solvent in the OTVD causing it to volatilize. Workers manually load or unload fabricated parts directly into or out of the vapor cleaning zone. The tank usually has chillers along the side of the tank to prevent losses of the solvent to the air. However, these chillers are not able to eliminate emissions, and throughout the degreasing process significant air emissions of the solvent can occur. These air emissions can cause issues with both worker health and safety as well as environmental issues. Additionally, the cost of replacing solvent lost to emissions can be expensive (NEWMOA, 2001). Figure_Apx E-1 illustrates a standard OTVD.



Figure_Apx E-1. Open Top Vapor Degreaser

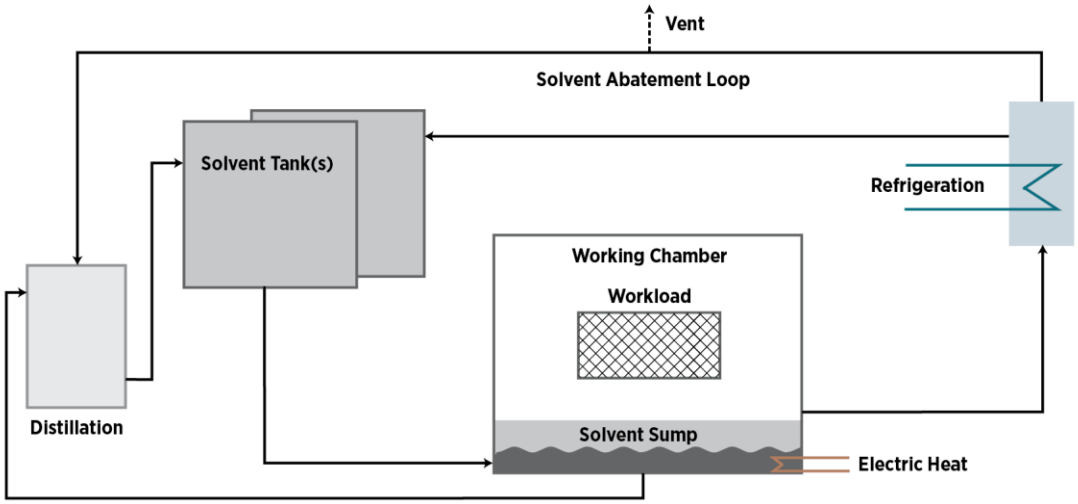
OTVDs with enclosures operate the same as standard OTVDs except that the OTVD is enclosed on all sides during degreasing. The enclosure is opened and closed to add or remove parts to/from the machine, and solvent is exposed to the air when the cover is open. Enclosed OTVDs may be vented directly to the atmosphere or first vented to an external carbon filter and then to the atmosphere (U.S. EPA; ICF Consulting, 2004). Figure_Apx E-2 illustrates an OTVD with an enclosure. The dotted lines in Figure_Apx E-2 represent the optional carbon filter that may or may not be used with an enclosed OTVD.



Figure_Apx E-2. Open Top Vapor Degreaser with Enclosure

E.1.3.2 Batch Closed-Top Vapor Degreasing

In closed-loop degreasers, parts are placed into a basket, which is then placed into an airtight work chamber. The door is closed, and solvent vapors are sprayed onto the parts. Solvent can also be introduced to the parts as a liquid spray or liquid immersion. When cleaning is complete, vapors are exhausted from the chamber and circulated over a cooling coil where the vapors are condensed and recovered. The parts are dried by forced hot air. Air is circulated through the chamber and residual solvent vapors are captured by carbon adsorption. The door is opened when the residual solvent vapor concentration has reached a specified level (Kanegsberg and Kanegsberg, 2011). Figure_Apx E-3 illustrates a standard closed-loop vapor degreasing system.



Figure_Apx E-3. Closed-Loop/Vacuum Vapor Degreaser

Airless degreasing systems are also sealed, closed-loop systems, but remove air at some point of the degreasing process. Removing air typically takes the form of drawing vacuum but could also include purging air with nitrogen at some point of the process (in contrast to drawing vacuum, a nitrogen purge operates at a slightly positive pressure). In airless degreasing systems with vacuum drying only, the cleaning stage works similarly as with the airtight closed-loop degreaser. However, a vacuum is generated during the drying stage, typically below 5 torr (5 mmHg). The vacuum dries the parts and a vapor recovery system captures the vapors (Kanegsberg and Kanegsberg, 2011; NEWMOA, 2001; U.S. EPA, 2001).

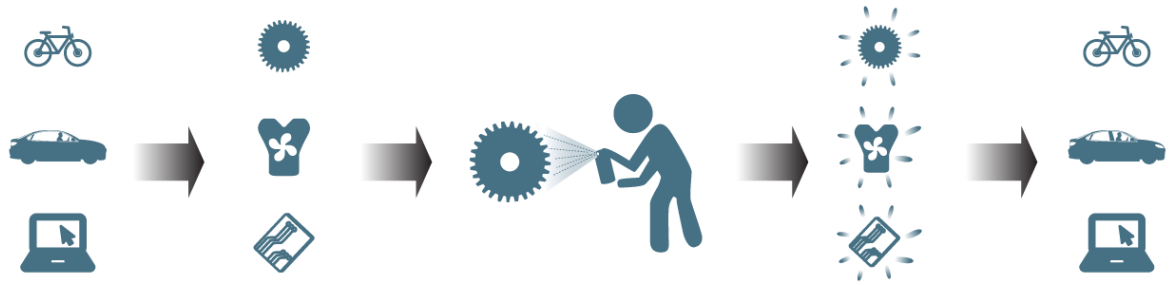
Airless vacuum-to-vacuum degreasers are true “airless” systems because the entire cycle is operated under vacuum. Typically, parts are placed into the chamber, the chamber sealed, and then vacuum drawn within the chamber. The typical solvent cleaning process is a hot solvent vapor spray. The introduction of vapors in the vacuum chamber raises the pressure in the chamber. The parts are dried by again drawing vacuum in the chamber. Solvent vapors are recovered through compression and cooling. An air purge then purges residual vapors over an optional carbon adsorber and through a vent. Air is then introduced in the chamber to return the chamber to atmospheric pressure before the chamber is opened (Durkee, 2014; NEWMOA, 2001). The general design of vacuum vapor degreasers and airless vacuum degreasers is similar as illustrated in Figure_Apx E-4 cleaning process.

E.1.3.3 Aerosol Degreasing

Aerosol degreasing is a process that uses an aerosolized solvent spray, typically applied from a pressurized can, to remove residual contaminants from fabricated parts. A propellant is used to aerosolize the formulation, allowing it to be sprayed onto substrates. The aerosol droplets bead up on the fabricated part and then drip off, carrying away any contaminants and leaving behind a clean surface. Similarly, aerosol lubricant products use an aerosolized spray to help free frozen parts by dissolving rust and leave behind a residue to protect surfaces against rust and corrosion.

A commenter (EPA-HQ-OPPT-2019-0131-0042) provided descriptions of their use of *trans*-1,2-dichloroethylene used as a nonflammable solvent for cleaning prior to installation of strain gages for instrumentation on test articles and in electrical fabrication and instrumentation installation to remove flux and other debris from electronic components for human-rated space vehicle hardware and other high performance applications, which the commenter also indicated was a critical use, further informing EPA's understanding of this condition of use.

Figure_Apx E-4 illustrates the typical process of using aerosol degreasing to clean components in commercial settings. One example of a commercial setting with aerosol degreasing operations is repair shops, where service items are cleaned to remove any contaminants that would otherwise compromise the service item's operation. Internal components may be cleaned in place or removed from the service item, cleaned, and then re-installed once dry (U.S. EPA, 2014).



Figure_Apx E-4. Overview of Aerosol degreasing

Aerosol degreasing may occur at either industrial facilities or at commercial repair shops to remove contaminants on items being serviced. Aerosol degreasing products may also be purchased and used by consumers for various applications.

E.1.3.4 Industrial and Commercial Cleaning and Furnishing Care Products

In the 2016 CDR, one company reported commercial use in cleaning and furnishing care products at a concentration of at least 90 percent (U.S. EPA, 2019b). This product is intended to be used as a spot cleaner of apparel and textiles (Albatross USA Inc., 2017). EPA was not able to find specific process information for the use of this product, or other cleaning and furnishing care products containing *trans*-1,2-dichloroethylene, but EPA plans to evaluate this condition of use during the risk evaluation.

E.1.3.5 Anti-Adhesive Agent

Safety data sheets reported *trans*-1,2-dichloroethylene use in mold release agents, ranging from 25 to 80 percent in formulation (Allied High Tech Products Inc, 2018; Miller-Stephenson Chemical, 2016a, b). Separately, a product data sheet for an aerosol cleaning aid and lubricant also indicated potential use as a mold release agent (Rainbow Technology, undated); therefore, aerosol use is possible. EPA has not

identified specific process information for the use of mold release agents containing *trans*-1,2-dichloroethylene but EPA plans to evaluate this condition of use during the risk evaluation.

E.1.3.6 Use as a Solvent (which become part of product formulation or mixture)

A safety data sheet for *trans*-1,2-dichloroethylene (55-65% percent purity) indicates recommended use as a urethane conformal coating (Miller-Stephenson Chemical, 2016a). However, specific use activities are unknown. EPA plans to investigate this use of *trans*-1,2-dichloroethylene during risk evaluation.

E.1.3.7 Lubricants and Greases

A safety data sheet reported use *trans*-1,2-dichloroethylene in a cleaning aid and lubricant, between 15 and 40 percent concentration (Rainbow Technology Corporation, 2019). The product data sheet indicate that it is used as a spray cleaner/degreaser in various applications (Rainbow Technology Corporation). Therefore, this use may be similar use in aerosol degreasing. EPA plans to evaluate the potential use of *trans*-1,2-dichloroethylene in this type of process during the risk evaluation.

E.1.3.8 Adhesives and Sealants

trans-1,2-Dichloroethylene-specific adhesive or sealant uses were not identified. The OECD ESD for Use of Adhesives (OECD, 2015) provides general process descriptions and worker activities for industrial adhesive uses, which may include application by spray, brush, or roll coating. EPA plans to evaluate this condition of use during risk evaluation.

E.1.3.9 Smoothing fluid in additive manufacturing

A safety data sheet for *trans*-1,2-dichloroethylene (60-100% percent purity) indicates recommended use as a cleaning agent (MicroCare, 2018) that is used for smoothing 3D printed plastic parts. However, specific use activities are unknown. EPA plans to investigate this use of *trans*-1,2-dichloroethylene during risk evaluation.

E.1.3.10 Refrigerant and Refrigeration System Flush

Safety data sheets report a refrigerant containing up to 25.3 percent *trans*-1,2-dichloroethylene (The Chemours Company FC LLC, 2019) and an air conditioning or refrigeration system flush treatment containing between 50 and 60 percent *trans*-1,2-dichloroethylene (ACE, 2015). EPA has not identified specific process information for the use of refrigerants and refrigeration system flush treatments containing *trans*-1,2-dichloroethylene but will investigate during risk evaluation.

E.1.3.11 Processing Aids

trans-1,2-Dichloroethylene has potential use as an extraction solvent for rubber, dyes, perfumes, lacquers, and thermoplastics. EPA has not identified specific process information for the use of processing aids containing *trans*-1,2-dichloroethylene but EPA plans to evaluate this condition of use during risk evaluation.

E.1.3.12 Propellants and Blowing Agents

Safety data sheets list *trans*-1,2-dichloroethylene as a component of polyurethane polyol formulation between 1 and 5 percent concentration (Demilec Inc, 2017a, b). The 2004 Draft Generic Scenario for Use of Additives in Foamed Plastics indicates that workers may potentially be exposed during transferring components from shipping containers, operation/supervision of the foam mix head or dispenser, during foam production, and transfer or handling of newly foamed articles (U.S. EPA, 2004b). EPA has not identified specific process information for the use of *trans*-1,2-dichloroethylene, EPA plans to evaluate this condition of use during risk evaluation.

E.1.3.13 Laboratory Use

A safety data sheet for *trans*-1,2-dichloroethylene (>95% percent purity) indicates recommended use as a laboratory chemical (Thermo Fisher Scientific, 2018). However, specific laboratory use activities are unknown. EPA plans to investigate the laboratory use of *trans*-1,2-dichloroethylene during risk evaluation.

A commenter (EPA-HQ-OPPT-2019-0131-0042) provided descriptions of their use of *trans*-1,2-dichloroethylene in testing of candidate alternative cleaning solvents for human-rated space vehicle hardware and other high-performance applications and laboratory use including such applications as analytical standards, research, equipment calibration, sample preparation, which the commenter also indicated was a critical use, further informing EPA's understanding of this condition of use.

E.1.4 Disposal

Each of the conditions of use of *trans*-1,2-dichloroethylene may generate waste streams of the chemical that are collected and transported to third-party sites for disposal, treatment, or recycling. Industrial sites that treat or dispose onsite wastes that they themselves generate will be assessed in each condition of use assessment. Similarly, point source discharges of *trans*-1,2-dichloroethylene to surface water will be assessed in each condition of use. Wastes of *trans*-1,2-dichloroethylene that are generated during a condition of use and sent to a third-party site for treatment or disposal may include wastewater and solid waste. *trans*-1,2-dichloroethylene may be contained in wastewater discharged to POTW or other, non-public treatment works for treatment.

Solid wastes are defined under RCRA as any material that is discarded by being: abandoned; inherently waste-like; a discarded military munition; or recycled in certain ways (certain instances of the generation and legitimate reclamation of secondary materials are exempted as solid wastes under RCRA).

E.2 Preliminary Occupational Exposure Data

EPA plans to consider available data and information related to worker exposure and environmental releases as they are identified during systematic review. Based on a preliminary data identification and evaluation, there are no OSHA Chemical Exposure and Health Data (CEHD) or NIOSH Health Hazard Evaluations specific to *trans*-1,2-dichloroethylene.

Appendix F SUPPORTING INFORMATION - CONCEPTUAL MODEL FOR INDUSTRIAL AND COMMERCIAL ACTIVITIES AND USES

Table_Apx F-1. Worker and Occupational Non-User Exposure Conceptual Model Supporting Table

Life Cycle Stage	Category	Subcategory	Release / Exposure Scenario	Exposure Pathway	Exposure Route	Receptor / Population	Plans to Evaluate	Rationale
Manufacturing	Domestic manufacture	Domestic manufacture	Manufacture of *trans*-DCE	Liquid Contact	Dermal	Worker	Yes	Workers are expected to routinely handle liquids containing *trans*-DCE.
				Vapor	Inhalation	Worker	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure to vapor.
	Import	Import	Repackaging of import containers	Liquid Contact	Dermal	ONU	No	Dermal exposure by ONU is not expected for this condition of use as they are not expected to directly handle the chemical.
				Vapor	Inhalation	ONU	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure to vapor.
Processing	Processing as a reactant	Plating agents and surface treating agents	Manufacture of plating agents and surface treating agents	Liquid Contact	Dermal	Worker	Yes	Workers are expected to routinely handle liquids containing *trans*-DCE.
				Vapor	Inhalation	Worker	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure to vapor.
		Intermediate in chemical product and preparation manufacturing	Manufacture of chemical products and other chemical preparations	Liquid Contact	Dermal	ONU	No	Dermal exposure by ONU is not expected for this condition of use as they are not expected to directly handle the chemical.
				Vapor	Inhalation	ONU	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure to vapor.

Life Cycle Stage	Category	Subcategory	Release / Exposure Scenario	Exposure Pathway	Exposure Route	Receptor / Population	Plans to Evaluate	Rationale
Processing	Processing – incorporation into formulation, mixture or reaction product	Solvents (for cleaning or degreasing) Solvents (which become part of product formulation or mixture) Adhesives and sealant chemicals Foam blowing additive Carrier solvent in adhesives, coatings, inks, lubricants, and silicones.	Formulation of mixture and products containing *trans*-DCE	Liquid Contact	Dermal	Worker	Yes	Workers are expected to routinely handle liquids containing *trans*-DCE.
				Vapor	Inhalation	Worker	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure to vapor.
				Liquid Contact	Dermal	ONU	No	Dermal exposure by ONU is not expected for this condition of use as they are not expected to directly handle the chemical.
				Vapor	Inhalation	ONU	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure to vapor.
Processing	Incorporation into articles	Propellant and blowing agent in plastics product manufacturing; flexible polyurethane foam manufacturing	Plastics product and flexible polyurethane foam manufacturing	Liquid Contact	Dermal	Worker	Yes	Workers are expected to routinely handle liquids containing *trans*-DCE.
				Vapor	Inhalation	Worker	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure to vapor.
				Liquid Contact	Dermal	ONU	No	Dermal exposure by ONU is not expected for this condition of use as they are not expected to directly handle the chemical.
				Vapor	Inhalation	ONU	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure to vapor.

Life Cycle Stage	Category	Subcategory	Release / Exposure Scenario	Exposure Pathway	Exposure Route	Receptor / Population	Plans to Evaluate	Rationale
Processing	Repackaging Recycling	Repackaging Recycling	Repackaging to large and small containers Recycling of *trans*-1,2,-dichloroethylene or solvents containing *trans*-1,2,-dichloroethylene	Liquid Contact	Dermal	Worker	Yes	Workers are expected to routinely handle liquids containing *trans*-DCE.
				Vapor	Inhalation	Worker	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure to vapor.
				Liquid Contact	Dermal	ONU	No	Dermal exposure by ONU is not expected for this condition of use as they are not expected to directly handle the chemical.
				Vapor	Inhalation	ONU	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure to vapor.
Distribution in commerce	Distribution in commerce	Distribution in commerce	Distribution of bulk shipments of *trans*-DCE and formulated products	Liquid Contact, Vapor	Dermal, Inhalation	Worker, ONU	Yes	EPA plans to analyze activities resulting in exposures associated with distribution in commerce (*e.g.*, loading, unloading) throughout the various lifecycle stages and conditions of use (*e.g.*, manufacturing, processing, industrial use, commercial use, disposal) rather than as a single distribution scenario.
Industrial/ commercial use	Solvents (for cleaning or degreasing)	Vapor degreaser	Use of vapor degreaser	Liquid Contact	Dermal	Worker	Yes	Workers are expected to routinely handle liquids containing *trans*-DCE.
				Vapor	Inhalation	Worker	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure. Exposure will depend on the specific type of degreasing system.
				Liquid Contact	Dermal	ONU	No	Dermal exposure by ONU is not expected for this condition of use as they are not expected to directly handle the chemical.
				Vapor	Inhalation	ONU	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure. Exposure will depend on the specific type of degreasing system.

Life Cycle Stage	Category	Subcategory	Release / Exposure Scenario	Exposure Pathway	Exposure Route	Receptor / Population	Plans to Evaluate	Rationale
Industrial/ commercial use	Solvents (for cleaning or degreasing)	Aerosol spray cleaner/degreaser	Use of aerosol spray cleaner / degreaser	Liquid Contact	Dermal	Worker	Yes	Workers are expected to routinely handle liquids containing *trans*-DCE.
				Vapor	Inhalation	Worker	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure.
				Mist	Inhalation	Worker	Yes	Known products are supplied in aerosol cans, therefore, spray application is expected.
				Mist	Inhalation	ONU	Yes	Known products are supplied in aerosol cans, therefore, spray application is expected.
				Liquid Contact	Dermal	ONU	No	Dermal exposure by ONU is not expected for this condition of use as they are not expected to directly handle the chemical.
				Vapor	Inhalation	ONU	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure.
Industrial/ commercial use	Solvents (for cleaning or degreasing)	Non-aerosol cleaner/degreaser	Use of non-aerosol spray cleaner / degreaser	Liquid Contact	Dermal	Worker	Yes	Workers are expected to routinely handle liquids containing *trans*-DCE.
				Vapor	Inhalation	Worker	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure.
				Mist	Inhalation	Worker, ONUs	No	Known products are supplied in non-aerosol cans, therefore, spray application is not expected.
				Liquid Contact	Dermal	ONU	No	Dermal exposure by ONU is not expected for this condition of use as they are not expected to directly handle the chemical.
				Vapor	Inhalation	ONU	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure.
Industrial/ commercial use	Solvents (for cleaning or degreasing)	Flux remover (liquid and aerosol)	Application of flux removers to substrates	Liquid Contact	Dermal	Worker	Yes	Workers may have dermal exposure to liquids when applying products containing *trans*-DCE.
				Vapor	Inhalation	Worker	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure to vapor.

Life Cycle Stage	Category	Subcategory	Release / Exposure Scenario	Exposure Pathway	Exposure Route	Receptor / Population	Plans to Evaluate	Rationale
				Mist	Inhalation	Worker	Yes	Mist generation is possible for aerosol products that are spray-applied.
				Mist	Inhalation	ONU	Yes	Mist generation is possible for aerosol products that are spray-applied.
				Liquid Contact	Dermal	ONU	No	Dermal exposure by ONU is not expected for this condition of use as they are not expected to directly handle the chemical.
				Vapor	Inhalation	ONU	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure to vapor.
Commercial use	Solvents (for cleaning or degreasing)	Refrigerant flush	Use of refrigerant flush	Liquid Contact	Dermal	Worker	Yes	Workers are expected to routinely handle liquids containing *trans*-DCE.
				Vapor	Inhalation	Worker	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure.
				Liquid Contact	Dermal	ONU	No	Dermal exposure by ONU is not expected for this condition of use as they are not expected to directly handle the chemical.
				Vapor	Inhalation	ONU	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure.
Industrial/ commercial use	Cleaning and furniture care products	Spot cleaner; stain remover	Use of spot cleaner / stain remover for textile	Liquid Contact	Dermal	Worker	Yes	Workers are expected to routinely handle liquids containing *trans*-DCE.
				Vapor	Inhalation	Worker	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure.
				Mist	Inhalation	Worker	Yes	Stain/ink remover is spray applied to textiles, therefore, EPA plans to evaluate exposure to mist.
				Mist	Inhalation	ONU	Yes	Stain/ink remover is spray applied to textiles, therefore, EPA plans to evaluate exposure to mist.
				Liquid Contact	Dermal	ONU	No	Dermal exposure by ONU is not expected for this condition of use as they are not expected to directly handle the chemical.
				Vapor	Inhalation	ONU	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure.

Life Cycle Stage	Category	Subcategory	Release / Exposure Scenario	Exposure Pathway	Exposure Route	Receptor / Population	Plans to Evaluate	Rationale
Industrial/ commercial use	Functional fluids (open systems)	Smoothing fluid in additive manufacturing	Additive manufacturing (3D printing)	Liquid Contact	Dermal	Worker	Yes	Workers may have incidental dermal exposure to liquids during 3D printing.
				Vapor	Inhalation	Worker	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure to vapor.
				Mist	Inhalation	Worker, ONU	No	Mist generation is expected to be negligible during 3D printing.
				Liquid Contact	Dermal	ONU	No	Dermal exposure by ONU is not expected for this condition of use as they are not expected to directly handle the chemical.
				Vapor	Inhalation	ONU	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure to vapor.
Industrial/ commercial use	Anti-adhesive agent	Mold release	Use of mold release products	Liquid Contact	Dermal	Worker	Yes	Workers are expected to routinely handle liquids containing *trans*-DCE.
				Vapor	Inhalation	Worker	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure.
				Mist	Inhalation	Worker	Yes	Some known products are applied via aerosol cans; therefore, spray application is expected.
				Mist	Inhalation	ONU	Yes	Some known products are applied via aerosol cans; therefore, spray application is expected.
				Liquid Contact	Dermal	ONU	No	Dermal exposure by ONU is not expected for this condition of use as they are not expected to directly handle the chemical.
				Vapor	Inhalation	ONU	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure.

Life Cycle Stage	Category	Subcategory	Release / Exposure Scenario	Exposure Pathway	Exposure Route	Receptor / Population	Plans to Evaluate	Rationale
Industrial/ commercial use	Solvents (which become part of product formulation or mixture)	Urethane coatings	Application of urethane coating	Liquid Contact	Dermal	Worker	Yes	Workers may have dermal exposure to liquids when applying products containing *trans*-DCE.
				Vapor	Inhalation	Worker	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure to vapor.
				Mist	Inhalation	Worker	Yes	Mist generation is possible for aerosol products that are spray-applied.
				Mist	Inhalation	ONU	Yes	Mist generation is possible for aerosol products that are spray-applied.
				Liquid Contact	Dermal	ONU	No	Dermal exposure by ONU is not expected for this condition of use as they are not expected to directly handle the chemical.
				Vapor	Inhalation	ONU	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure to vapor.
Industrial/ commercial use	Lubricants and greases	Liquid and spray lubricants and greases, and penetrating lubricants	Use of aerosol degreaser/cleaner	Liquid Contact	Dermal	Worker	Yes	Workers are expected to routinely handle liquids containing *trans*-DCE.
				Vapor	Inhalation	Worker	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure.
				Mist	Inhalation	Worker	Yes	Some known products are applied via aerosol cans; therefore, spray application is expected.
				Mist	Inhalation	ONU	Yes	Mist generation is possible for aerosol products that are spray-applied.
				Liquid Contact	Dermal	ONU	No	Dermal exposure by ONU is not expected for this condition of use as they are not expected to directly handle the chemical.
				Vapor	Inhalation	ONU	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure.

Life Cycle Stage	Category	Subcategory	Release / Exposure Scenario	Exposure Pathway	Exposure Route	Receptor / Population	Plans to Evaluate	Rationale
Industrial/ commercial use	Adhesives and sealants	Solvent-based adhesives and sealants; adhesive accelerant	Application of adhesives, sealants, and adhesive accelerants	Liquid Contact	Dermal	Worker	Yes	Workers are expected to routinely handle liquids containing *trans*-DCE.
				Vapor	Inhalation	Worker	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure.
				Mist	Inhalation	Worker	Yes	Some known products are applied via spray guns; therefore, spray application is expected.
				Mist	Inhalation	ONU	Yes	Some known products are applied via spray guns; therefore, spray application is expected.
				Liquid Contact	Dermal	ONU	No	Dermal exposure by ONU is not expected for this condition of use as they are not expected to directly handle the chemical.
				Vapor	Inhalation	ONU	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure.
Industrial/commercial use	Functional fluids (closed systems)	Refrigerant	Use of refrigerant	Liquid Contact	Dermal	Worker	Yes	Workers are expected to routinely handle liquids containing *trans*-DCE.
				Vapor	Inhalation	Worker	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure.
				Liquid Contact	Dermal	ONU	No	Dermal exposure by ONU is not expected for this condition of use as they are not expected to directly handle the chemical.
				Vapor	Inhalation	ONU	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure.

Life Cycle Stage	Category	Subcategory	Release / Exposure Scenario	Exposure Pathway	Exposure Route	Receptor / Population	Plans to Evaluate	Rationale
Industrial/ commercial use	Processing aids	Extraction solvent for thermoplastics	Use of processing solvent in industrial applications	Liquid Contact	Dermal	Worker	Yes	Workers are expected to routinely handle liquids containing *trans*-DCE.
				Vapor	Inhalation	Worker	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure.
				Liquid Contact	Dermal	ONU	No	Dermal exposure by ONU is not expected for this condition of use as they are not expected to directly handle the chemical.
				Vapor	Inhalation	ONU	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure.
Commercial use	Propellants and blowing agents	Polyurethane foam building insulation	Application of Polyurethane Foam Insulation	Liquid Contact	Dermal	Worker	Yes	Workers are expected to routinely handle liquids containing *trans*-DCE.
				Vapor	Inhalation	Worker	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure.
				Mist/Particulate	Inhalation	Worker	Yes	Several polyurethane foam products are designed to be spray-applied
				Mist/Particulate	Inhalation	ONU	Yes	Several polyurethane foam products are designed to be spray-applied
				Liquid Contact	Dermal	ONU	No	Dermal exposure by ONU is not expected for this condition of use as they are not expected to directly handle the chemical.
				Vapor	Inhalation	ONU	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure.
Industrial/ commercial use	Other use	Laboratory chemicals	Use of laboratory chemicals	Liquid Contact	Dermal	Worker	Yes	Workers are expected to routinely handle liquids containing *trans*-DCE.
				Vapor	Inhalation	Worker	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure.
				Liquid Contact	Dermal	ONU	No	Dermal exposure by ONU is not expected for this condition of use as they are not expected to directly handle the chemical.
				Vapor	Inhalation	ONU	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure.

Life Cycle Stage	Category	Subcategory	Release / Exposure Scenario	Exposure Pathway	Exposure Route	Receptor / Population	Plans to Evaluate	Rationale
Disposal	Disposal	Disposal	Worker handling of wastes	Liquid Contact	Dermal	Worker	Yes	Workers are expected to routinely handle liquids containing *trans*-DCE.
				Vapor	Inhalation	Worker	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure.
				Liquid Contact	Dermal	ONU	No	Dermal exposure by ONU is not expected for this condition of use as they are not expected to directly handle the chemical.
				Vapor	Inhalation	ONU	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure.

Appendix G SUPPORTING INFORMATION – CONCEPTUAL MODEL FOR CONSUMER ACTIVITIES AND USES

Table_Apx G-1. Consumer Exposure Conceptual Model Supporting Table

Life Cycle Stage	Category	Subcategory	Release from source	Exposure Pathway	Route	Receptor	Plans to Evaluate	Rationale
Consumer Use; Consumer Reuse and Recycling	Solvents (for cleaning or degreasing)	Aerosol spray cleaner/degreaser	Use of aerosol spray cleaner / degreaser	Liquid Contact	Dermal	Consumers	Yes	Consumers can potentially handle liquids containing *trans*-1,2-dichloroethylene.
				Vapor	Inhalation	Consumer, Bystanders	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure.
				Mist	Inhalation	Consumer, Bystanders	Yes	Known products are supplied in aerosol cans, therefore, spray application is expected.
	Adhesives and Sealants	Solvent-based; adhesives accelerant	Use of solvent-based; adhesives accelerant	Liquid Contact	Dermal	Consumers	Yes	Consumers can potentially handle liquids containing *trans*-1,2-dichloroethylene.
				Vapor	Inhalation	Consumer, Bystanders	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure.
				Mist	Inhalation	Consumer, Bystanders	Yes	Known products are supplied in aerosol cans, therefore, spray application is expected.
	Propellants and blowing Agents	Polyurethane foam building insulation	Off-gassing of *trans*-1,2-dichloroethylene from polyurethane foam insulation	Vapor	Inhalation	Consumer, Bystanders	Yes	Due to high volatility (331 mmHg at room temperature), EPA plans to evaluate inhalation exposure

Appendix H SUPPORTING INFORMATION – CONCEPTUAL MODEL FOR ENVIRONMENTAL RELEASES AND WASTES

Table_Apx H-1. General Population and Environmental Exposure Conceptual Model Supporting Table

Life Cycle Stage	Category	Release	Exposure Pathway / Media	Exposure Routes	Receptor / Population	Plans to Evaluate	Rationale
All	Emissions to Air	Emissions to Air	Near facility ambient air concentrations	Inhalation	General Population	Yes	*trans*-1,2-dichloroethylene ambient air and deposition to nearby bodies of water and soil are expected exposure pathways, not covered under other EPA regulations
			Indirect deposition to nearby bodies of water and soil catchments	Oral Dermal	General Population	Yes	
				TBD	Aquatic and Terrestrial Receptors	Yes	
		Hazardous and Municipal Waste Incinerator	Near facility ambient air concentrations/ Indirect deposition to nearby bodies of water and soil catchments	Inhalation	General Population	No	Stationary source releases of *trans*-1,2-dichloroethylene to ambient air are under the jurisdiction of the RCRA and CAA.
				TBD	Aquatic and Terrestrial Species		
	Wastewater or Liquid Wastes	Industrial pre-treatment and wastewater treatment, or POTW	Direct release into surface water and indirect partitioning to sediment	TBD	Aquatic and Terrestrial Receptors	Yes	EPA has developed Ambient Water Quality Criteria for protection of human health for *trans*-1,2-dichloroethylene
				Oral Dermal	General Population	No	
			Drinking Water via Surface or Ground Water	Oral Dermal and Inhalation (*e.g.*, showering)	General Population	No	The drinking water exposure pathway for *trans*-1,2-dichloroethylene is currently addressed in the NPDWR.

Life Cycle Stage	Category	Release	Exposure Pathway / Media	Exposure Routes	Receptor / Population	Plans to Evaluate	Rationale
			Biosolids: application to soil and/or migration to groundwater and/or surface water	Oral (*e.g.*, ingestion of soil) Inhalation	General Population	No	Unlikely to be a route to general population.
				TBD	Aquatic and Terrestrial receptors	Yes	
		Underground injection	Migration to groundwater, potential surface/drinking water	Oral Dermal Inhalation	General Population	No	*trans*-1,2-Dichloroethylene is released to Class I Underground Injection Wells which are covered by SDWA and RCRA.
					Aquatic and Terrestrial Species		
				TBD			
Disposal	Solid and Liquid Wastes	Hazardous, Municipal landfill and other land disposal	Leachate to soil, ground water and/or mitigation to surface water	Oral Dermal	General Population	No	*trans*-1,2-dichloroethylene is included on the list of hazardous wastes pursuant to RCRA 3001 (40 CFR §§ 261.33).
				TBD	Aquatic and Terrestrial Receptors		

Appendix E Technical Data Sheets for Spray Foam Insulation Used during 10 Morton Street Home Renovations

UPC 2.0

TECHNICAL DATA SHEET & SPRAY GUIDELINES **CCRR-0345**

UPC 2.0 CLOSED-CELL SPRAY FOAM

UPC 2.0 is a two-component, medium density, one to one by volume spray polyurethane foam (SPF) system. UPC 2.0 system consists of an "A" component (ISO) and a blended "B" component (Resin) in separate drums. UPC 2.0 system utilizes HFC-245fa blowing agents.

Physical Properties					
Core Density	ASTM D1622	2.0 pcf ± 0.10	**Tensile Strength**	ASTM D1623	50 psi
R-Value @ 1"	ASTM C518	6.8	**Air Permeance @ 1"**	ASTM E2178 @ 75 PA	< 0.02 L/sm²
Water Vapor Permeance	ASTM C355	0.98 @ 1.5 inch	**Dimensional Stability**	ASTM D2126	-20°F: N/C | 158°F @ 100%RH: <0.5%
Closed Cell Content	ASTM D1940	93%	**Compressive Strength**	ASTM E1621	35 psi
Intertek Certified Clean Air Gold: Conforms to California Department of Public Health (CDPH) Standard Method v1.2: Private Office and School Classroom				CDPH 01350 v1.2: PO, SC, R for VOC emissions and formaldehyde	
Liquid Properties		**A-SIDE: PMDI Isocyanate**		**B-SIDE: UPC 2.0 Resin**	
Color		Brown		Light Amber	
Viscosity (Brookfield cps) @ 77°F		200 ± 30		650 ± 100	
Specific Gravity		1.24		1.23	
Mixing Ratio (volume)		1:1		1:1	
Fire Test Results					
Flammability		ASTM E84 @ 4"		25 Flame Spread | 165 Smoke Development	
Large Scale Fire Testing: Ignition Barrier		AC 377 Appendix X*		PASS: NO COATING	
Large Scale Fire Testing: Thermal Barrier		NFPA 286*		PASS: 18 Wet Mils DC 315 or 14 Wet Mils No-Burn	
Reactivity Profile					
Cream Time	0-1 seconds	**Gel Time**	2 seconds	**Tack Free**	3-4 seconds	**End of Rise**	3-5 seconds

• See Intertek CCRR-0345 for additional instructions or consult with UPC's Technical Department for details at 203.760.0025.

PROCESSING PARAMETERS

Pressure (Dynamic)
• 1000-1400 psi, depending on mix chamber

Machine Temperature
• A-Side: 105° to 125°F (41° to 52°C)
• B-Side: 105° to 125°F (41° to 52°C)

Hose Heat Temperature
• 105° to 125°F (41° to 52°C)

Substrate Temperature
• UPC 2.0 Regular: 50° to 80°F (10° to 27°C)
• UPC 2.0 Summer: 80° to 120°F (27° to 49°C)
• UPC 2.0 Winter: 20° to 50°F (-7° to 10°C)

Drum Temperature
• A-Side: 50° to 75°F (10° to 24°C)
• B-Side: 50° to 75°F (10° to 24°C)

• **MAXIMUM PASS THICKNESS: 2 Inches**

• Optimal temperature and pressure setting are affected by the equipment being used, as well as ambient and substrate temperatures.

• **Important**: Many factors affect yield, including substrate temperature, substrate type, and pass thickness. Multiple passes will significantly reduce yield. Larger mixing chamber sizes and higher pressure settings will also reduce yield.

PROCESSING INSTRUCTIONS - READ CAREFULLY

Agitation	DO NOT agitate.
Drum Temperatures & Recirculation	DO NOT RECIRCULATE. Starting chemical temperatures in the drums should be between 50°-75°F for both the A-Side & B-Side drums. Use laser thermometer or inlet temp gauge to measure drum temp (A-Side drum should NEVER be warmer than B-Side drum). If drum is below 50°F, then slowly raise temp with warming blanket or heated storage. NEVER super-heat with portable heater. If drum is too hot then blowing agent will boil-off.
Substrate Condition	Substrate must be clean, dry, and moisture content <19%. Substrate temp should be >5°F above dew point. When substrate temperature is below 45°F, pre-heat building. When heating with portable heaters, if concrete or metal substrate only heat to 50°F, otherwise condensation may form. Never use portable propane heaters. When substrates temps are above 80°F and below 30°F, switch to summer or winter blends accordingly.
Contamination	B-Side is sensitive to contamination from other products. Never combine this product with any other product and never combine open-cell with closed-cell products. Transfer pumps must be properly cleaned between product.
Spray Technique	Spray up-and-down approx 18" from surface. The further away you spray, the colder the chemical will be when reaching substrate. Layering will reduce yield, but make smoother. When substrate temp is below 35°F, may need ½" priming layer to improve adhesion.
Metal | Concrete Applications	When applying on metal or concrete you may need a ½" priming layer. Increase temperatures by 2°-5°F to account for heat loss from these surfaces.
Max Pass Thickness	Max pass thickness is 2". If the foam is applied too hot or too thick, will overheat foam and cause burnt or "fishy" odor, result in future shrinkage, or possibly lead to fire hazard (including spontaneous combustion). 2nd layer may be applied after 1st layer is hard to the touch. **Important: Core foam temp should never exceed 270°F.**
Temperature Settings	As a general rule of thumb, the hose temperature is the most important setting and should be set first. The A-Side is set 2°-5°F higher than the hose. The B-Side is set 2°-5°F higher than the A-Side.
High Altitude	At higher elevations, A-Side & B-Side temps may have to be set the same as the hose. Foam expands better at high elevation, be careful to control pass thickness.

PROCESSING INSTRUCTIONS (CONTINUED)

Heated Hose	A poorly insulated hose may not be able to maintain adequate hose heat and drastically change required temp settings on primary heaters. Never Increase hose temp above 145°F, you can burn the hose.
Maximizing Yield | Dialing-In Temps	Dozens of factors affect yield, but properly dialing in temps and # of layers is critical. Ideal core temp should be 240°-260°F, this is the yield sweet spot (use a digital meat thermometer to test the core temp). DO NOT exceed 270°F. For experienced sprayers, start temperatures cold enough that the rising foam sags slightly, then increase temps 5°F at a time until sagging stops. Many thin layers will reduce yield significantly.
Pressure Settings	Mix pressure settings to the Gun for 01 mix chamber should be @ 1000 psi, for 02 @ 1200 psi. Higher fluid pressure settings create more mist and require greater distance from the cavity, resulting in more over spray. Higher pressure will generally lower yield. Air purge pressure set 80-100 psi.

TROUBLESHOOTING GUIDE

Delamination	If foam delaminates from substrate, it may be from cold substrate. Apply an initial ½" priming layer to improve adhesion. Another cause may be excess moisture in substrate; try reducing A-Side temps by 5°-7°F to reduce ISO reactivity. Spraying over uncured foam may also cause delamination.
Blistering	If foam creates voids and blisters behind foam, it may be from too much moisture in substrate. Apply a flash layer pass to the substrate, then apply regular pass as normal. IF spraying on metal and blisters form, try increasing thickness of initial pass (no less than ½").
Elongated Cell Structure	If the foam has stretched or elongated cells, then it is likely too hot. Try reducing all temps by 5°F.
Large Cell Structure	If the foam has consistently large cell structure,then the B-Side Resin may be contaminated with open-cell resin or contaminated or worn out mix chamber.
Crunchy or Gummy	If foam is crunchy and amber in color, then foam may be ISO rich and off-ratio. If "gummy" consistency, then foam may be resin rich. Check equipment. Cured foam should be snappy in consistency when broken apart.
Chalky | Brittle	Too hot. Lower all heaters by 5°-7°F. If problem does not resolve, lower temperature by another 5°F, and repeat.
Curing Too Fast	If the closed-cell is curing too fast, then it is too hot and could result in future cracking. Lower temperatures by 3°F or as needed.
Curing Too Slow	If the closed-cell is curing too slow, then it is too cold and you may see a narrow spray pattern. Raise temperatures by 5°-7°F or as needed.
Gun is Clogging Often	If the mixing chamber needs constant cleaning, then foam may be too hot. Lower temperatures by 3°-5°F or as needed. Also check gun air settings.
Poor Yield	Too Cold: substrate, process temp or too large mix chamber. If temperatures are dialed-in too cold, then lack of heat will generate poor chemical reactivity & poor yield (See "Drum Temperatures" & "Maximizing Yield" under Processing Instructions). Check chemical expiration.
Pulls Away From Studs	If pulls away or "shrinks" from studs over time, then foam was applied too hot, too thick, or second layer applied over hot foam.
Important	Minimum drum temperature of 50°F is necessary to bring viscosities of A-Side & B-Side in alignment to prevent off-ratio foam and increase yield; setting chemical temperatures above recommendations may result in B-Side frothing. If the B-Side drum is over 85°F, then the blowing agent may boil and cause imbalance pressure in proportioner.
Frothing	UPC 2.0 contains a dissolved blowing agent. If the B-Side drum is overheated or excessively agitated, the chemical may froth out. Using winter formula in summer temps may also contribute to frothing or imbalance pressure in proportioner.

Cautions and Recommendations

UPC 2.0 is designed for installation in most standard construction configurations using common materials such as, concrete, metal, and wood products. The foam should not be used when the continuous service temp of the substrate is >180°F. Foam plastic installed in walls or ceilings may present a fire hazard unless protected by an approved, fire-resistant thermal barrier with a finish rating of not less than 15 minutes as required by building codes. Rim joists/header areas in accordance with the IRC® and IBC®, may not require additional protection. Foam plastic must also be protected against ignition by code-approved materials in attics and crawl spaces or as code approved alternatives apply.

As with all SPF systems, improper application techniques should be avoided and any defective product replaced with properly installed materials. Examples of improper application techniques include but are not limited to, excessive application thickness, off-ratio material and spraying into or under rising liquid foam. Additionally, off-ratio materials can result in offensive odors that may not dissipate. It is the responsibility of the applicator to understand how their equipment works.

Job-site Warnings

Applicators should ensure the safety of the job-site and construction personnel. SPF Insulation is combustible and appropriate signs shall be posted warning that all "hot work" such as welding, soldering, and cutting with torches should not take place until a thermal barrier or approved equivalent is installed over any exposed polyurethane foam.

Contractors should communicate with other trades working in proximity to the spray application area. Appropriate warning signs at each entryway must be posted that clearly indicates that spray foam activity is taking place and proper respiratory protection is required to enter. Non SPF personnel and occupants should be vacated from the building during the application of SPF. Proper Ventilation during spraying and afterwards at minimum 10 Air changes per hour. **Re-entry**: Ventilate for 2 hours before personal protective equipment is no longer required for trades and inspectors. **Re-occupancy:** After 24 hours of continuous ventilation, building may be re-occupied.

Health and Safety Information

Before working with this product, you must read and become familiar with available information, including the Safety Data Sheet (SDS), regarding the risks, proper use and safe handling. All contractors and applicators must use appropriate respiratory, skin and eye Personal Protective Equipment (PPE) when handling and processing spray foam systems.

Refer to the Center for the Polyurethanes Industries (CPI): "Guidance for Developing a Written Respiratory Protection Program", "Guidance on Best Practices for the Installation of Spray Polyurethane Foam", and "Spray Polyurethane Foam Product Stewardship Guidance". Available at www.spraypolyurethane.org and www.upcfoam.com.

Shelf Life and Storage

UPC 2.0 has a shelf life of approximately 4 months from the date of manufacture when stored in original, unopened containers at 50°-75°F. This material should be stored in a secure location and never in direct sunlight. Storage temperatures above the recommended range will shorten shelf life.

Vapor Retarder

When installed at a minimum of 1.5-inch, UPC 2.0 is considered a Class II vapor retarder. Consult with local code officials for specific requirements Climate zone tables are available in current IBC® and IRC® publications.

DISCLAIMER: Please read all information in the general guidelines, technical data sheets, application guide and safety data sheets (SDS) before applying material. UPC products are for Professional Use only and preferably applied by professionals who have prior experience with the UPC products or have undergone training in application of UPC products. Published Technical data and instructions are subject to change without notice. Contact your local Universal Polymers representative or visit our website for current technical data and instructions. All guidelines, recommendations, statements, and technical data contained herein are based on information and tests we believe to be reliable and correct, but accuracy and completeness of said tests are not guaranteed and are not to be construed as a warranty, either expressed or implied. It is the user's responsibility to satisfy himself, by his own information and tests, to determine suitability of the product for his own intended use, application and job situation and user assumes all risk and liability resulting from his own use of the product. We do not suggest or guarantee that any hazards listed herein are the only ones that may exist. Neither seller nor manufacturer shall be liable to the buyer or any third party for any injury, loss or damage directly or indirectly resulting from use of, or inability to use, the product. Recommendations or statements, whether verbal or in writing, other than those contained herein shall not be binding upon the manufacturer, unless in writing and signed by a corporate officer of the manufacturer. Technical and application information is provided for establishing a general profile of the material and proper application procedures. Test performance results were obtained in a controlled environment and Universal Polymers makes no claim that these tests or any other tests, accurately represent all environments. UPC is not responsible for typographical errors.

UPC 500 CLASSIC

TECHNICAL DATA SHEET & SPRAY GUIDELINES **CCRR-0358**

UPC 500 CLASSIC OPEN-CELL SPRAY FOAM

UPC 500 Classic is a two component, water blown (zero ozone depleting chemical) light density, open-cell spray polyurethane foam (SPF) system that is designed to improve the performance of the building envelope for interior commercial, residential and industrial applications.

Physical Properties					
Core Density	ASTM D1622	0.5 pcf ± 0.05	**Tensile Strength**	ASTM D1623	3.35 psi
R-Value @ 1”	ASTM C518	4.2	**Air Permeance @ 3.5”**	ASTM E2178 @ 75 PA	0.00431
Water Vapor Permeance	ASTM E96	8.4 Perms at 2”	**Dimensional Stability**	ASTM D2126	< 3.8%
Intertek Certified Clean Air Gold: Conforms to California Department of Public Health (CDPH) Standard Method v1.2: Private Office and School Classroom				CDPH 01350 v1.2: PO, SC, R for VOC emissions and formaldehyde	

Liquid Properties	**A-SIDE: PMDI Isocyanate**	**B-SIDE: UPC 500 Classic Resin**
Color	Brown	Amber
Viscosity (Brookfield cps) @ 77°F	200 ± 30	360 ± 100
Specific Gravity	1.24	1.07
Mixing Ratio (volume)	1:1	1:1

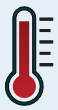
Fire Test Results	
Flammability	ASTM E84 @ 4” / 15 Flame Spread | 200 Smoke Development
Large Scale Fire Testing: Ignition Barrier	AC 377 Appendix X* / PASS: 6 Wet Mils DC 315
Large Scale Fire Testing: Thermal Barrier	NFPA 286* / PASS: 18 Wet Mils DC 315 | 14 Wet Mils No-Burn
Alternative Unvented Attic Assembly*: End Use Configuration Testing	Conforming to IBC Section 1202.3 or IRC Section R806.5 / Approved for certain attics without a prescriptive ignition barrier or intumescent coating

NFPA 259	1,796 Btu/ft² @ 3.5”	**NFPA 285**	PASS

Reactivity Profile							
Cream Time	1-2 seconds	**Gel Time**	3-4 seconds	**Tack Free**	6-7 seconds	**End of Rise**	6-7 seconds

• See Intertek CCRR-0358 for additional instructions or consult with UPC’s Technical Department for details at 203.760.0025.

PROCESSING PARAMETERS



Pressure (Dynamic)
• 1200-1400 psi while spraying

Machine Temperature
• A-Side: 122° to 137°F (50° to 58°C)
• B-Side: 115° to 140°F (46° to 60°C)

Hose Heat Temperature
• 115° to 140°F (46° to 60°C)

Substrate Temperature
• UPC 500: 35° to 120°F (2° to 49°C)

Drum Temperature
• A-Side: 75° to 100°F (24° to 38°C)
• B-Side: 75° to 100°F (24° to 38°C)

• Optimal temperature and pressure setting are affected by the equipment being used, as well as ambient and substrate temperatures.

• Important notice regarding yield and density. Many factors affect yield, including substrate temperature, substrate type, and pass thickness. Multiple passes will significantly reduce yield. Larger mixing chamber sizes and higher pressure settings will also reduce yield.

PROCESSING INSTRUCTIONS - READ CAREFULLY

Agitation	Agitation not required, but for optimal performance or older drum, we recommend high speed for 20-30 mins prior to spraying. Agitation NOT needed during application. Recommended agitators: Graco collapsing blade Agitator #26C818 or #26C150.
Drum Temperatures & Recirculation	Recirculate as needed to achieve chemical temperatures in the drums of 75°-95°F for both the A-Side & B-Side drums (this is necessary to bring viscosities of A-Side & B-Side in alignment to prevent off-ratio foam and increase yield). When recirculating, set the primary heater for the A-Side to 100°F and B-Side to 130°F. Use laser thermometer or inlet temp gauge to measure drum temp (A-Side drum should NEVER be warmer than B-Side drum).
Substrate Condition	Substrate must be clean, dry, and moisture content <19%. Substrate temp should be >5°F above dew point. When substrate temperature is below 45°F, pre-heat building. When heating with portable heaters, if concrete or metal substrate only heat to 50°F, otherwise condensation may form. Never use portable propane heaters.
Spray Technique	Spray side-to-side approx 18" from surface recommended. The further away you spray, the colder the chemical will be when reaching substrate, and potential for voids. Reverse picture frame technique is also suggested if desired.
High Humidity	When the dew point is greater than 65°F, reduce the A-Side temperature by 5°F +/- to reduce ISO reactivity/blow backs.
Contamination	B-Side is sensitive to contamination from other products. Never combine this product with any other product and never combine open-cell with closed-cell products. Transfer pumps must be properly cleaned between product. Recirculating lines must be properly flushed before recirculating.
Max | Min Pass Thickness	Max practical pass thickness is 6-8" before resulting in splash-back. Min recommended pass thickness is 3", except when flash-coat needed.
Proper Temperature Settings	As a general rule of thumb, the hose temperature is the most important setting and should be set first. The A-Side is set 2-5°F higher than the hose. The B-Side is set 3°-10°F higher than the A-Side depending on humidity levels. If ambient conditions are hot and dry, all temps may be set the same.
High Altitude	At higher elevations, A-Side & B-Side temps may have to be set the same as the hose.
Heated Hose	The hose temp is the most important setting and should be set first to desired final chemical temp at gun. Hose temp should rarely be adjusted. Primary heaters should be increased if chemical is too cold. A poorly insulated hose may compromise adequate heating and drastically change required temp settings. Never Increase hose temp above 145°F, you can burn the hose.

PROCESSING INSTRUCTIONS (CONTINUED)

Maximizing Yield | Dialing-In Temps	Dozens of factors affect yield, but properly dialing in temps has the biggest impact. For open-cell, start temperatures hot enough that the foam shrinks slightly from the studs, then lower temps 3°F at a time until shrinkage stops - this is the yield sweet spot.
Pressure Settings	Higher fluid pressure settings create more mist and require greater distance from the cavity, resulting in more over spray. Higher pressure will generally lower yield. As a rule-of-thumb, you should practice spraying as close to 1000 psi as practical.

TROUBLESHOOTING GUIDE

Poor Adhesion Between Layers or 'Fish Eye' Cells	If the foam does not adhere to itself and/or contains large random cells that appear like “fish eyes”, it may be caused by trapped steam between layers. Allow the 1st layer to cool before applying 2nd layer.
Pulls Away From Studs or Deflates	If pulls away or "shrinks" from studs within a few seconds, then foam is too hot. Lower primary heaters and hose temperatures by 3°F. Spray out chemical in hose (approx 2-3 gallons) until reduced temp is achieved. If problem does not resolve, lower temp by another 3°F, and repeat process until resolved. If foam pulls away from studs several minutes after application, then chemical may be contaminated.
Voids Behind Foam or Delamination	Four possible causes: 1. If “stringy hairs” between the substrate and foam (“coconut hairs”), the foam may be too cold. Increase all heaters by 5°F. Spray out chemical in hose until new increased temps achieved. Repeat process until problem is resolved. 2. If not “stringy” and skin of foam is “crusty”, then foam may be too hot. Decrease temps in 5°F. 3. Substrate moisture content may be too high. Try lowering A-Side 5°F and call Tech Support. 4. Substrate too cold, try a 1/8-¼” initial flash coat.
Voids & Shrinking	If foam creates voids and shrinks from studs at the same time, then increase B-Side drum temp only to 100°F. Machine ΔT may be too low.
Beehive Cell Structure	If the foam has consistently large cell structure, like a "beehive", then the foam may be too cold. Increase all heaters by at least 10°-15°F. If problem persists, chemical may be contaminated.
Color	If the foam appears yellowish or "marbling", then it is too cold. Primary heaters should be increased 3°-5°F. Should appear "white".
Crunchy or Gummy	If foam is crunchy and amber in color, then foam may be ISO rich and off-ratio. If “gummy” consistency, then foam may be resin rich. Check equipment.
Poor Yield	Many factors affect yield, including low substrate temp, metal or concrete substrates, thin layers, multiple layers, larger mixing chamber sizes, higher pressure settings, and off-ratio foam. If temperatures are dialed-in too cold, then lack of heat will generate poor chemical reactivity & poor yield (See “Drum Temperatures” & “Maximizing Yield” under Processing Instructions). B-Side may not be thoroughly mixed, may need agitating. Check chemical expiration.
Important	Regardless of proportioner heating capacity, never spray from cold drum chemical. Powerful primary heaters may scorch B-Side resin. Follow "Drum Temperatures & Recirculation" procedures under Processing Instructions.

Cautions and Recommendations

UPC 500 CLASSIC is designed for installation in most standard construction configurations using common materials such as, concrete, metal, and wood products. Foam plastic installed in walls or ceilings may present a fire hazard unless protected by an approved, fire-resistant thermal barrier with a finish rating of not less than 15 minutes as required by building codes. Rim joists/header areas in accordance with the IRC® and IBC®, may not require additional protection. Foam plastic must also be protected against ignition by code-approved materials in attics and crawl spaces, or as code approved alternatives apply.

As with all SPF systems, improper application techniques should be avoided and any defective product replaced with properly installed materials. Examples of improper application techniques include but are not limited to, excessive application thickness, off-ratio material and spraying into or under rising liquid foam. Additionally, off-ratio materials can result in offensive odors that may not dissipate. It is the responsibility of the applicator to understand how their equipment works.

Job-site Warnings

Applicators should ensure the safety of the job-site and construction personnel. SPF Insulation is combustible and appropriate signs shall be posted warning that all “hot work” such as welding, soldering, and cutting with torches should not take place until a thermal barrier or approved equivalent is installed over any exposed polyurethane foam.

Contractors should communicate with other trades working in proximity to the spray application area. Appropriate warning signs at each entryway must be posted that clearly indicates that spray foam activity is taking place and proper respiratory protection is required to enter. Non SPF personnel and occupants should be vacated from the building during the application of SPF. Proper Ventilation during spraying and afterwards at minimum 10 Air changes per hour. **Re-Entry**: Ventilate for 2 hours before personal protective equipment is no longer required for trades and inspectors. **Re-Occupancy**: After 24 hours of continuous ventilation, building may be re-occupied.

Health and Safety Information

Before working with this product, you must read and become familiar with available information, including the Safety Data Sheet (SDS), regarding the risks, proper use and safe handling. All contractors and applicators must use appropriate respiratory, skin and eye Personal Protective Equipment (PPE) when handling and processing spray foam systems.

Refer to the Center for the Polyurethanes Industries (CPI): “Guidance for Developing a Written Respiratory Protection Program”, “Guidance on Best Practices for the Installation of Spray Polyurethane Foam”, and “Spray Polyurethane Foam Product Stewardship Guidance”. Available at www.spraypolyurethane.org and www.upcfoam.com.

Shelf Life and Storage

UPC 500 CLASSIC has a shelf life of approximately six months from the date of manufacture when stored in original, unopened containers at 50-80°F. This material should be stored in a secure location and never in direct sunlight. Storage temperatures above the recommended range will shorten shelf life.

Vapor Retarder

UPC 500 CLASSIC is intended for indoor applications, and is a Class III vapor retarder. It is vapor semi-permeable and will allow for some diffusion of moisture through the insulation. The following considerations are needed:

(1) An additional vapor retarder may be needed in certain building envelopes in climate zones 5 and higher when not meeting the conditions of IRC Table 402.5.1. Refer to local building codes.

(2) A vapor retarder also needs to be considered where high interior humidity conditions exist.

DISCLAIMER: Please read all information in the general guidelines, technical data sheets, application guide and safety data sheets (SDS) before applying material. UPC products are for Professional Use only and preferably applied by professionals who have prior experience with the UPC products or have undergone training in application of UPC products. Published Technical data and instructions are subject to change without notice. Contact your local Universal Polymers representative or visit our website for current technical data and instructions. All guidelines, recommendations, statements, and technical data contained herein are based on information and tests we believe to be reliable and correct, but accuracy and completeness of said tests are not guaranteed and are not to be construed as a warranty, either expressed or implied. It is the user’s responsibility to satisfy himself, by his own information and tests, to determine suitability of the product for his own intended use, application and job situation and user assumes all risk and liability resulting from his own use of the product. We do not suggest or guarantee that any hazards listed herein are the only ones that may exist. Neither seller nor manufacturer shall be liable to the buyer or any third party for any injury, loss or damage directly or indirectly resulting from use of, or inability to use, the product. Recommendations or statements, whether verbal or in writing, other than those contained herein shall not be binding upon the manufacturer, unless in writing and signed by a corporate officer of the manufacturer. Technical and application information is provided for establishing a general profile of the material and proper application procedures. Test performance results were obtained in a controlled environment and Universal Polymers makes no claim that these tests or any other tests, accurately represent all environments. UPC is not responsible for typographical errors.